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CONFERENCE OF THE COMMITTEE ON DISARMAMENT

CCD/429
11 July 1974
Original: ENGLISH

NIGERIA

Letter dated 5 July 1974 from the Permanent Representative of Nigeria to the Special Representative of the Secretary-General to the CCD

I have the honour to refer to our conversation of 2 July 1974, regarding some minor errors and omissions which have, unfortunately, crept into the reproduction of my statement in your record of the 638th Meeting of the Conference of the Committee on Disarmament (document CCD/PV.638 of 23 May 1974) and to reproduce hereunder the last sentence of the statement, as we discussed:

"We are glad to note, however, that the Indian Government through its distinguished representative, Ambassador Mishra, has declared its intention to use its newly acquired nuclear capability solely and exclusively for peaceful purposes."

As I am anxious that a definitive version of my statement should be on record, I shall be glad if you will kindly consult the Co-Chairmen with a view to apprising the Committee of the particular omission to which I referred above.

(Signed) B. AKPORODE CLARK
Ambassador,
Permanent Representative

GE.74-67305
74-22844

CONFERENCE OF THE COMMITTEE ON DISARMAMENT

CCD/430
12 July 1974
Original: ENGLISH

JAPAN

Working Paper containing views of Japanese experts on the scope of prohibition and on the verification for organophosphorus compounds for the informal meetings with participation of experts of the CCD in 1974

I. The scope of prohibition

Annex I, deriving from Article IV of the "Draft Convention on the Prohibition of the Development, Production and Stockpiling of Chemical Weapons and on Their Destruction" which was submitted by the delegation of Japan on April 30, 1974 (CCD/420), is expected to list, in the schedule, chemical agents provisionally suspended from the prohibition (Alternative A) or chemical agents to be prohibited from the beginning (Alternative B). Therefore, the content of the schedule will cause the scope of prohibition to vary at the first stage; however the scope should be determined by the adequacy of applied verification. In this connexion, in view of the present feasibility of effective verification measures, which is to be discussed in part II of this working paper, it will be realistic to list super-toxic organophosphorus compounds, among others, as chemical agents to be prohibited from the beginning, whether or not we adopt I (A) or I (B). Our views on the schedule of Annex I are as follows:

1. Annex I (A) will list chemical agents provisionally suspended from the prohibition, namely, chemical agents other than the super-toxic organophosphorus compounds which are not used for peaceful purposes. One way of selecting these chemical agents may be to adopt the toxicity level of chlorine as a lower threshold, as suggested in the Canadian working paper (CCD/414) and in the Swedish working paper (CCD/427) and to list dual purpose chemical agents, placing organophosphorus compounds having the equivalent toxicity level of Lct_{50} = 20,000 mg. min/m^3 on a lower threshold. However it must be noted that there is a difficulty in adopting this way in that few data have been disclosed concerning the inhalent toxicity value of organophosphorus compounds. This difficulty will be eliminated if more data are disclosed in some way or another or if it is agreed to replace it with the toxicity value determined by some other administration route such as the toxicity value determined by intraperitoneal administration, about which many data have already been published.

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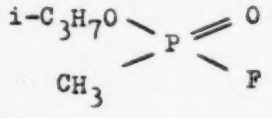
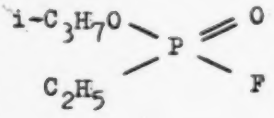
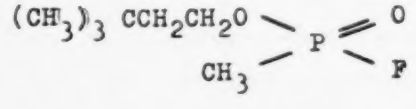
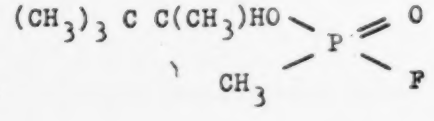
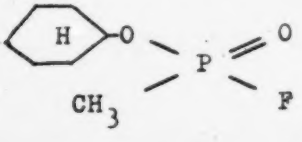
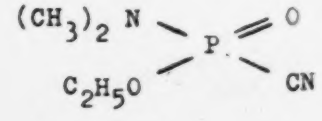
2. Annex I (B) is to list the chemical agents to be prohibited from the beginning, i.e., certain super-toxic organophosphorus compounds. In listing these, it is necessary to take into consideration three criteria: (i) a toxicity level (LD_{50} = 0.62 mg/kg i.p., LD_{50} = 0.50 mg/kg S.C.) that Japan has suggested as an objective criterion; (ii) chemical formulae; (iii) whether or not chemical agents have no peaceful use. Mainly by the first two criteria, we have chosen, from published data, super-toxic organophosphorus compounds to be prohibited from the beginning and listed some of them as an example in Table I.

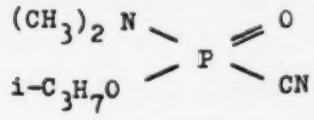
In selecting the agents falling in these criteria, questions may arise concerning the ways of dealing with high toxic chemical agents used for peaceful purposes and not known to be used at present for military purposes, but which could potentially be used for the latter (e.g., Echothiophate used for medicine). It may seem illogical to list chemical agents for peaceful purposes in the schedule insofar as Article I adopts purpose criteria, but, on the other hand, it may also be argued that they should be listed as dual purpose chemical agents in view of their potentiality of being used for military purposes. In any case, whether or not we list them under the category of the prohibited chemical agents depends upon our judgement concerning the degree of their potentiality of being used for military purposes.

With regard to the toxicity level, the problem of international standardization concerning procedures of estimating lethal dose has yet to be solved. However, it will be made possible to make a list of chemical agents to be prohibited by selecting the lowest LD_{50} value, measured under the condition that the same species and the same administration routes are employed, out of LD_{50} values which have been reported and may be reported in the future.

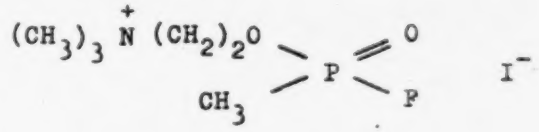
Table 1. Some supertoxic organophosphorus compounds to be listed in the schedule to Annex I (B)

No.	Chemical Name (Code Name) Chemical Formula
1.	Isopropyl methyl phosphonofluoridate (Sarin, GB) 
2.	Isopropyl ethyl phosphonofluoridate (Ethyl Sarin,GE) 
3.	3,3-Dimethylbutyl methyl phosphonofluoridate 
4.	Pinacolyl methyl phosphonofluoridate (Soman) 
5.	Cyclohexyl methyl phosphonofluoridate (GF) 
6.	Ethyl N,N-dimethyl phosphoramidocyanidate (Tabun) 

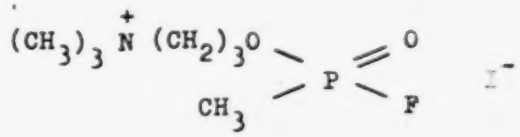
7. Isopropyl N,N-dimethyl phosphoramidocyanidate



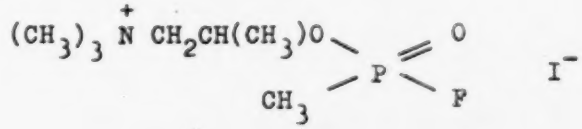
8. 2-Trimethylammoniumethyl methyl phosphonofluoridate iodide



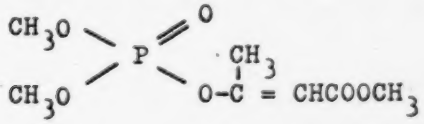
9. 3-Trimethylammoniumpropyl methyl phosphonofluoridate iodide



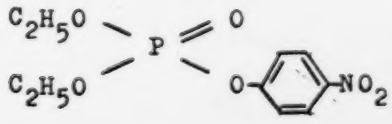
10. 2-Trimethylammonium-1-methylethyl methyl phosphonofluoridate iodide



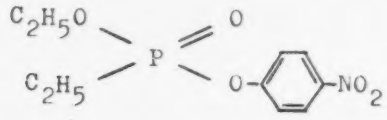
11. Dimethyl 1-methyl-2-carbomethoxyvinyl phosphate (α -phosdrin)



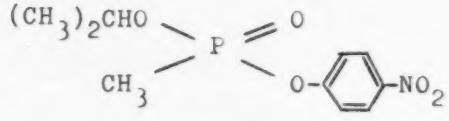
12. Diethyl 4-nitrophenyl phosphate (Paraoxon, E-600, Mintacol)



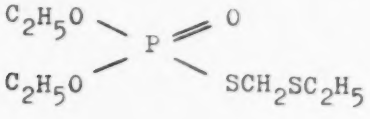
13. Ethyl 4-nitrophenyl ethylphosphonate (Armin)



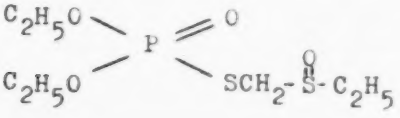
14. Isopropyl 4-nitrophenyl methylphosphonate



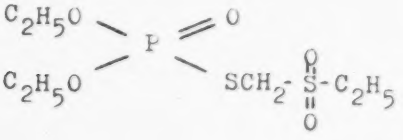
15. O,O-Diethyl S-ethylthiomethyl phosphorothioate



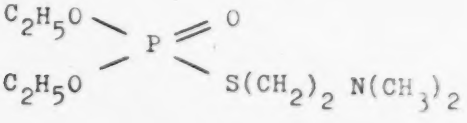
16. O,O-Diethyl S-ethylsulphinylmethyl phosphorothioate



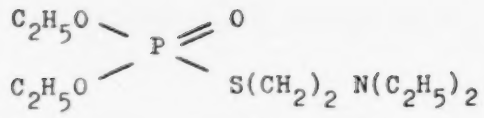
17. O,O-Diethyl S-ethylsulfonylmethyl phosphorothioate



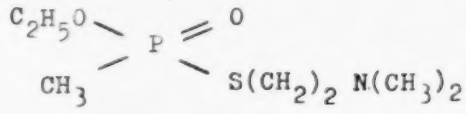
18. O,O-Diethyl S-(2-dimethylaminoethyl) phosphorothioate (217 AO)



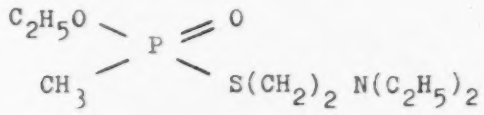
19. O,O-Diethyl S-(2-diethylaminoethyl) phosphorothioate (Tetram, DSDP)



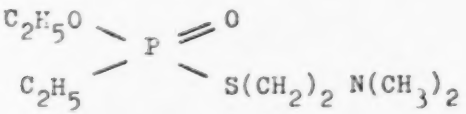
20. O-Ethyl S-(2-dimethylaminoethyl) methylphosphonothiolate (33 SN)



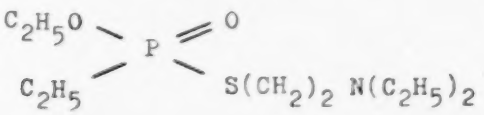
21. O-Ethyl S-(2-diethylaminoethyl) methylphosphonothiolate (Edemo, VM)



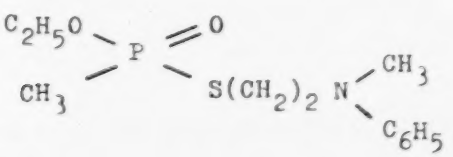
22. O-Ethyl S-(2-dimethylaminoethyl) ethylphosphonothiolate



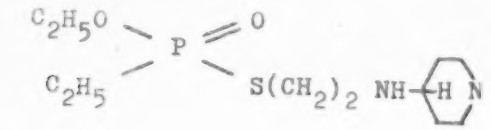
23. O-Ethyl S-(2-diethylaminoethyl) ethylphosphonothiolate (VE)



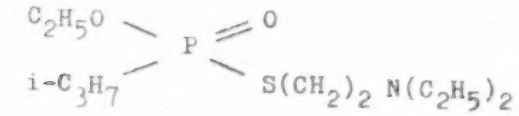
24. O-Ethyl S-(2-methylphenylaminoethyl) methylphosphonothiolate (GT 23)



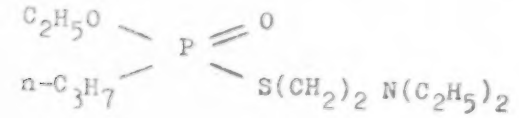
25. O-Ethyl S-(2-piperidylaminoethyl) ethylphosphonothiolate



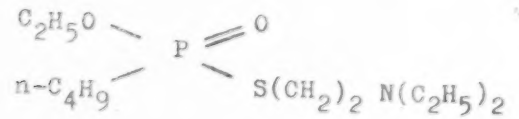
26. O-Ethyl S-(2-diethylaminoethyl) i-propylphosphonothiolate



27. O-Ethyl S-(2-diethylaminoethyl) n-propylphosphonothiolate



28. O-Ethyl S-(2-diethylaminoethyl) n-butylphosphonothiolate



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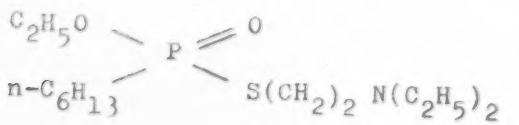
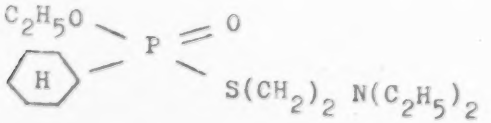
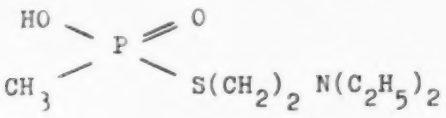


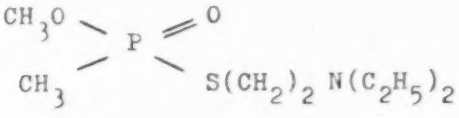
30. O-Ethyl S-(2-diethylaminoethyl) cyclohexylphosphonothiolate



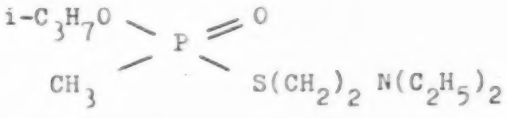
31. O-Hydrogen S-(2-diethylaminoethyl) methylphosphonothiolate (S 27)



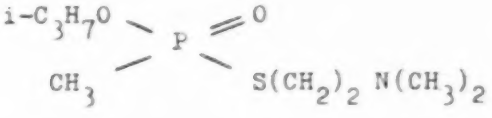
32. O-Methyl S-(2-diethylaminoethyl) methylphosphonothiolate



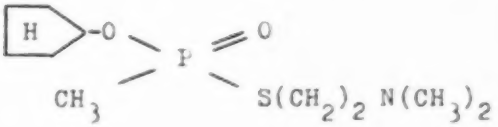
33. O-Isopropyl S-(2-diethylaminoethyl) methylphosphonothiolate (37 SN)



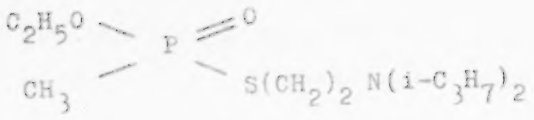
34. O-Isopropyl S-(2-dimethylaminoethyl) methylphosphonothiolate



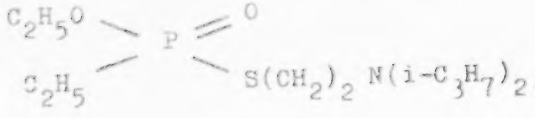
35. O-Cyclopentyl S-(2-dimethylaminoethyl) methylphosphonothiolate



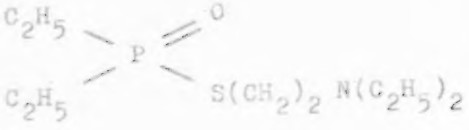
36. O-Ethyl S-(2-diisopropylaminoethyl) methylphosphonothiolate



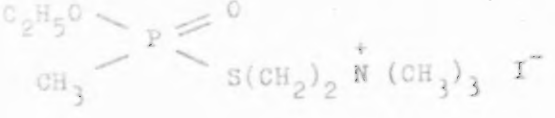
37. O-Ethyl S-(2-diisopropylaminoethyl) ethyl-phosphonothiolate (VS)



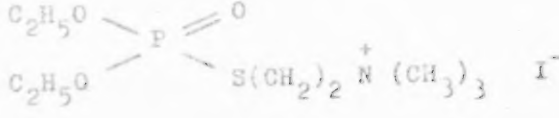
38. 2-Diethylaminoethylthio diethyl phosphine oxide



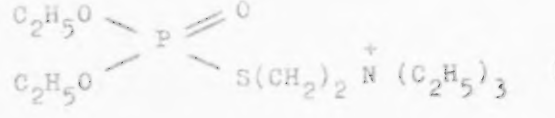
39. O-Ethyl S-(2-trimethylammoniumethyl) methyl-phosphonothiolate iodide



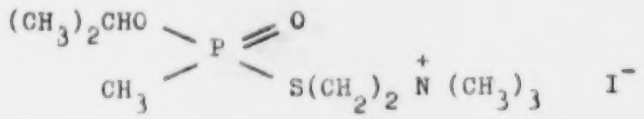
40. O,C-Diethyl S-(2-trimethylammoniumethyl) phosphorothioate iodide (Echothiophate, Phospholin)



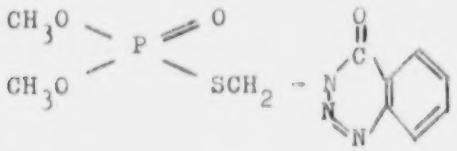
41. O,O-Diethyl S-(2-triethylammoniumethyl) phosphorothioate iodide



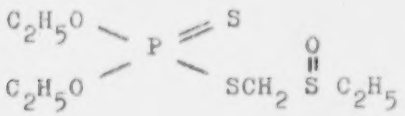
42. O-Isopropyl S-(2-trimethylammoniumethyl) methylphosphonothiolate iodide



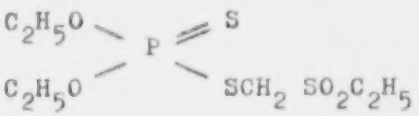
43. O,O-Dimethyl S-(4-oxo-3-H-1,2,3-benzotriazine-3-methyl) phosphorothioate (Guthion)



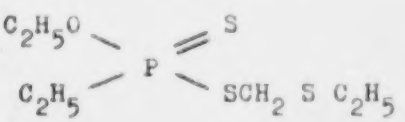
44. O,O-Diethyl S-ethylsulphinylmethyl phosphorodithioate



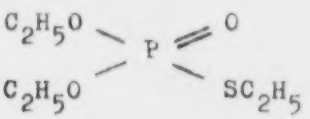
45. O,O-Diethyl S-ethylsulfonylmethyl phosphorodithioate



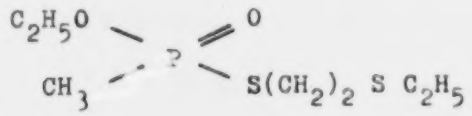
46. O-Ethyl S-(ethylthiomethyl) ethylphosphonodithioate



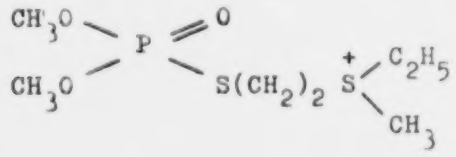
47. O,O-Diethyl S-ethyl phosphorothioate



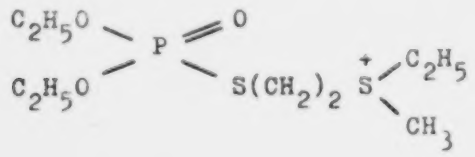
48. O-Ethyl S-(2-ethylthioethyl) methylphosphonothioate



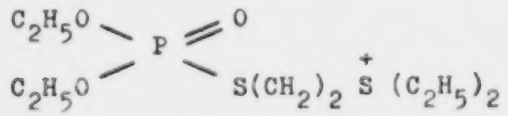
49. O,O-Dimethyl S-[2-(S'-methyl-S'-ethylsulfonium) ethyl] phosphorothioate



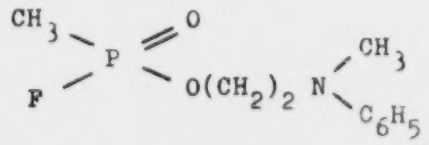
50. O,O-Diethyl S-[2-(S'-methyl-S'-ethylsulfonium) ethyl] phosphorothioate



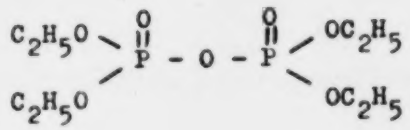
51. O,O-Diethyl S-[2-(S'-diethylsulfonium)ethyl] phosphorothioate



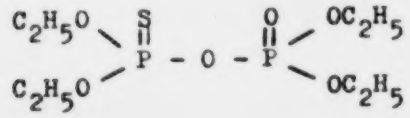
52. O-(2-N-methyl-N-phenylamino)ethyl methyl phosphonofluoridate



53. Tetraethyl pyrophosphate (TEPP)



54. Tetraethyl monothionopyrophosphate



II. Verification of super-toxic organophosphorus compounds.

1. Various methods of verification which have so far been suggested in working papers and other forms by many countries can be classified and summarized in the following table.

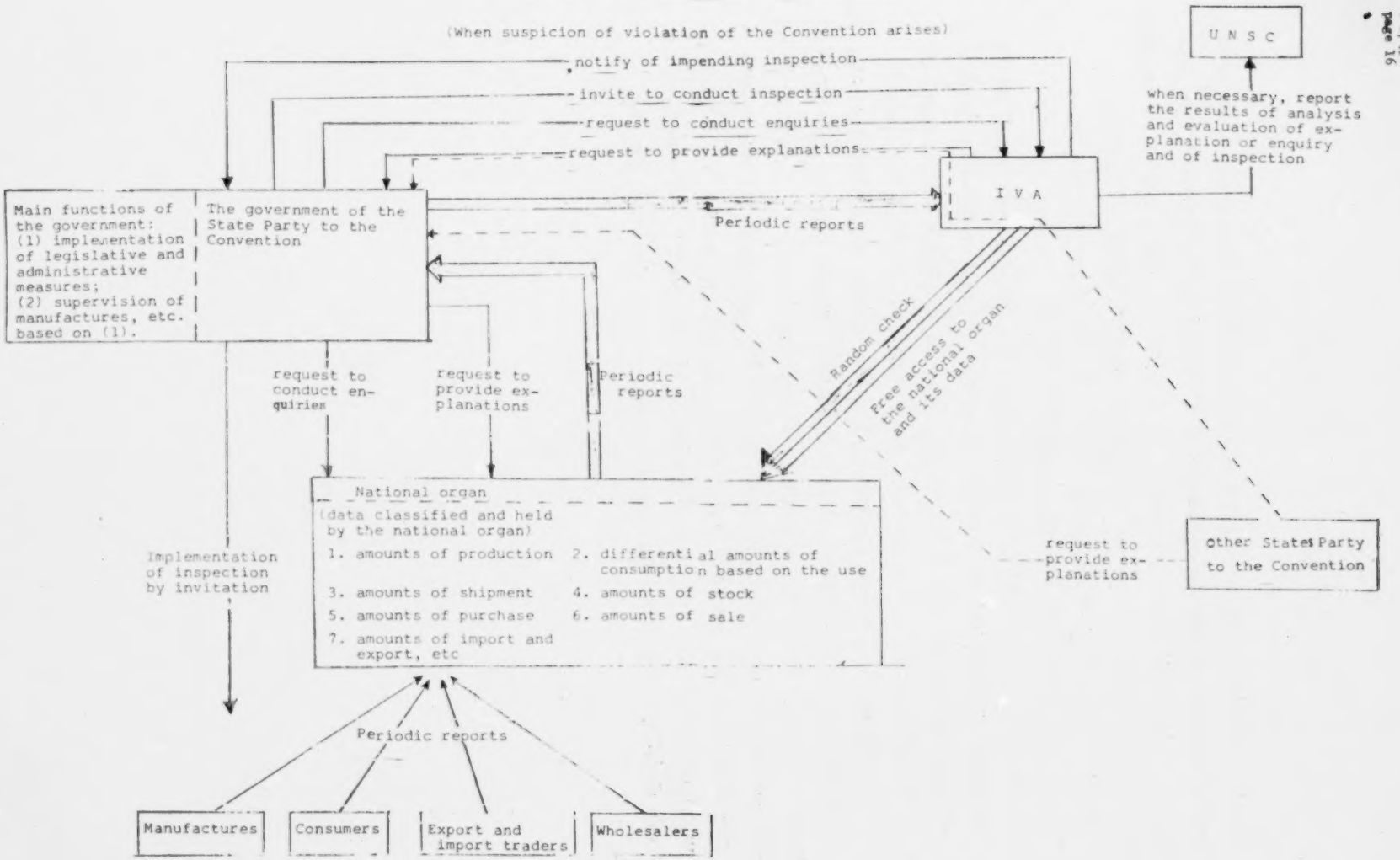
Table 2. Relationship between Verification Modes and Verification Techniques

Verification Modes		Details of Verification Technique
On-site Inspection	Methods of Verification	Example
(I) Direct Inspection (II) Indirect Inspection (III) Inspection by Invitation	(1). Investigation of Production, Equipment and Facilities etc.	Experts from, for example, the IVA, etc., will investigate: the production-process, their equipment and facilities, and production control etc.
	(2). Investigation of safety control on production etc.	Experts from, for example, the IVA, etc., will investigate: the safety control on production equipment and facilities, and workers health control (e.g., measurement of cholinesterase activities) etc.
	(3). Sampling and subsequent analysis	Application of the following analytical techniques Gas-chromatography, Infrared- and Ultraviolet-spectrophotometry, other chromatographic techniques (T.L.C. etc.), Nuclear-magnetic resonance, Mass-spectrometry, etc.
	(4). Investigation of records and data	Investigation of the following records and data; (1). the amounts of production, consumption, and loss in industry of the raw-materials and intermediates for CW-agents. (2). records of budgets for production (3). records of accidents in factories
	(5). Oral inquiry and questionnaires	Oral interrogation of and questionnaires answered by industry workers, managers, administrators. etc.
	(6). Investigation of the surroundings of industries.	(1). Sampling and subsequent analysis of the surroundings of industries. (2). Questionning the inhabitants of the surrounding areas of industries. (3). External observation of industries by photographic reconnaissance. etc.
Verification methods other than on-site Inspection	(1). Remote Observation (remote sensors)	Monitoring by satellite and by neighbouring countries, etc.
	(2). Statistical Reporting Systems	(1). Analysis of economic data involving the amounts of production, consumption, exports and imports for the raw-materials and the intermediates of CW-agents. (2). Analysis of the related data which should be submitted, etc.
	(3). Surveillance of literatures	Surveillance of related information, as well as various literatures, including patent literature, such as chemical engineering, pyrotechnics, meteorology and military equipment, etc.
	(4). Budgetary Investigation (5). Inquiry of records and data (6). Inquiry by questionnaire	Investigation and inquiry of the records and data which the national organ has, and interrogation by questionnaire of all employees, e.g., administrators, managers, technicians, workers, etc., of the national organ. etc.
	(7). Others	

2. By choosing a good combination of the verification measures shown above or by taking certain steps which would supplement one verification measure, the most effective results in checking violations will be obtained. This has been recognized by a SIPRI publication as well as by the working papers of Japan (CCD/301), the United States (CCD/311, CCD/368), Italy (CCD/373), Yugoslavia (CCD/377), Sweden (CCD/395) and the Socialist Countries (CCD/403).

However, the crux of the matter lies in the need to satisfy two conflicting requirements: to obtain verification results reliable enough to be able to deter the non-compliance of the Convention and at the same time to minimize the burden of States Parties to the Convention. From this point of view the Japanese draft convention (CCD/420) places its major emphasis upon verifications other than inspection, considering non-intrusive verifications as supplementary measures. As for "Remote Observation (sensors)" in "Verification methods other than on-site inspection", of the Table 2 shown above, it depends much upon further technological development. Therefore, of the "verification methods other than on-site inspection", (2) to (6) are expected to play a major role for the time being. An example of verification measures which the Japanese draft convention foresees can be depicted in the following chart.

Chart of an example of verification measures


(When suspicion of violation of the Convention arises)
notify of impending inspection
invite to conduct inspection
request to conduct enquiries
request to provide explanations
U N S C
when necessary, report the results of analysis and evaluation of explanation or enquiry and of inspection
I V A
Main functions of the government: (1) implementation of legislative and administrative measures; (2) supervision of manufactures, etc. based on (1).
The government of the State Party to the Convention
Periodic reports
Random check
Free access to the national organ and its data
request to conduct enquiries
request to provide explanations
Periodic reports
National organ
(data classified and held by the national organ)
1. amounts of production
2. differential amounts of consumption based on the use
3. amounts of shipment
4. amounts of stock
5. amounts of purchase
6. amounts of sale
7. amounts of import and export, etc
request to provide explanations
Other States Party to the Convention
Implementation of inspection by invitation
Periodic reports
Manufactures
Consumers
Export and import traders
Wholesalers

3. As shown in the above chart, the reporting system of statistical data constitutes the keystone of the draft convention (CCD/420). However, as pointed out in the United States' working paper (CCD/311, CCD/368), this reporting system involves the following problems:

(1) Errors of statistical data are unavoidable;

(2) Statistical data vary irregularly in the course of years;

(3) Methods of collecting data differ depending upon countries;

(4) There exists time lag in data collected.

In addition, there is the more important problem of ensuring the credibility of data.

(1) and (2) above are essentially unavoidable and accordingly, have to be left aside tentatively. (3) and (4) can be solved to some extent through the unification by the International Verification Agency (IVA) of the methods of collecting and reporting data. As for the credibility of data, in the field of statistics, the credibility of data is obtained through the method of random check, and hence, it would be necessary to adopt this method in banning chemical weapons. In this sense, it would be necessary to ensure the right of free access by the IVA to various data possessed by the national organ.

In order that the reporting system may be adopted as one of the verification measures, study on its concrete contents must first be made. (For instance, a SIPRI Monograph entitled "Chemical Disarmament: Some Problems of Verification" provides excellent guidance as a concrete example of useful verification measures. By the same token, working papers of the socialist countries (CCD/403), the United States (CCD/311) and Italy (CCD/373), etc., contain useful suggestions). Generally speaking, among activities involving chemical weapons -- development, production, stockpiling, destruction, etc., production is considered to be the most susceptible to verification measures. This is because production covers considerably wide areas, normally from the unloading of raw materials or intermediate products to the loading of the end products, and also because production contains many aspects which become the objects of verification such as administration of production, safety, and labour and such as measures for preventing environmental contamination. In other words, production contains a variety of elements which can be used for verification. Accordingly, in studying the reporting system on organophosphorus compounds, emphasis should be placed on production. (This

assertion is also made in working papers and in suggestions concerning verification so far put forward to the CCD by many countries. Outside the CCD, likewise, detailed study was made regarding the possibility of verifying the production of organophosphorus compounds at the symposium held by SIPRI in 1971).

Based on these considerations, the report to be submitted from each State Party to the IVA must grasp the movement from the unloading of raw material or intermediates to the loading of end products -- of the following 7 substances, which are thought to be closely related to the production of organophosphorus chemical warfare agents: (This is also suggested in Japan's working paper (CCD/301 of 1970, which proposed verification measures including the establishment of the reporting system.

(1) Yellow phosphorus; (2) phosphorus trichloride; (3) phosphorus oxychloride; (4) phosphorus pentachloride; (5) phosphorus pentasulfide; (6) dimethyl phosphite; (7) methyl phosphoryl dichloride.

At the CCD in the summer of 1971, Japan tabled a working paper (CCD/344) introducing statistical data which indicated the amounts of final respective uses of phosphorus trichloride and phosphorus oxychloride as well as their proportions to the whole amount. According to this working paper, the amounts of respective uses of phosphorus trichloride were; agricultural and sterilizing chemicals 2714t; vinyl chloride stabilizer 1229t; dyestuffs 642t; medicine 99t; others 353t. They totaled 5037t. Furthermore, the latest rough figures obtained unofficially and from disclosures at academic symposiums have led to the analysis of the "others" mentioned above as fire-resistent chemicals, antioxidant, catalyzer, agent for chlorination, etc., which amounted to 316-356t, thus identifying more than 90 per cent of the "others".

In view of the above, the Japanese experts propose the formulation of the Figure "Differential amounts of consumption based on the use of raw material and intermediates" and Table 3 "Statistical data of production, imports, consumption and shipment of raw materials and intermediates". The aforementioned Figure would be useful immediately in checking the amounts of raw material and intermediates; how the raw material and intermediates are used is not entirely known. Likewise, Table 3 would be useful in checking the balance between the input and output of raw material and intermediates. Logically, this Figure and Table 3 are mutually related and the overall evaluation of them is expected to strengthen the credibility of the economic data and could serve as an effective means of verification. In order

to further increase the credibility, the economic data to be reported from each State Party to the IVA should include, in addition to the items indicated in the Figure and in table 3, the list of facilities producing the aforementioned 7 types of raw material and intermediates and the production capabilities of States; priority consideration should be given to the inclusion of this list.

Admittedly, more careful study should be made concerning the contents of the report, mainly with a view to increasing the credibility of statistical data. At the same time, the data to be possessed by the national organ in formulating the report must be those which are tenable as the basis of data or items reported to the IVA and which can render the report convincing. Accordingly, the national organ would be required to receive a monthly report containing considerably detailed data from the facilities dealing with the above-mentioned 7 types of raw material and intermediates. The minimum content of such a monthly report would be as follows:

(1) Importers; amounts imported.

(2) Producers; amounts produced, amounts loaded, amounts in stock, and production capabilities.

(3) Wholesalers; amounts purchased, amounts sold.

(4) Users; amounts purchased.

(5) Exporters; amounts shipped.

The IVA must be given the right of free access to the national organ so that it may check the above-mentioned records and data.

In order to enhance the verification effects as much as possible, studies should be made as to how these data can be made as detailed and timely as possible and also as to the use of some parameters for the purpose of cross-checking in the fields of software, such as environmental protection, labour administration, etc.

Figure Differential amounts of consumption based on the use of raw material and intermediates

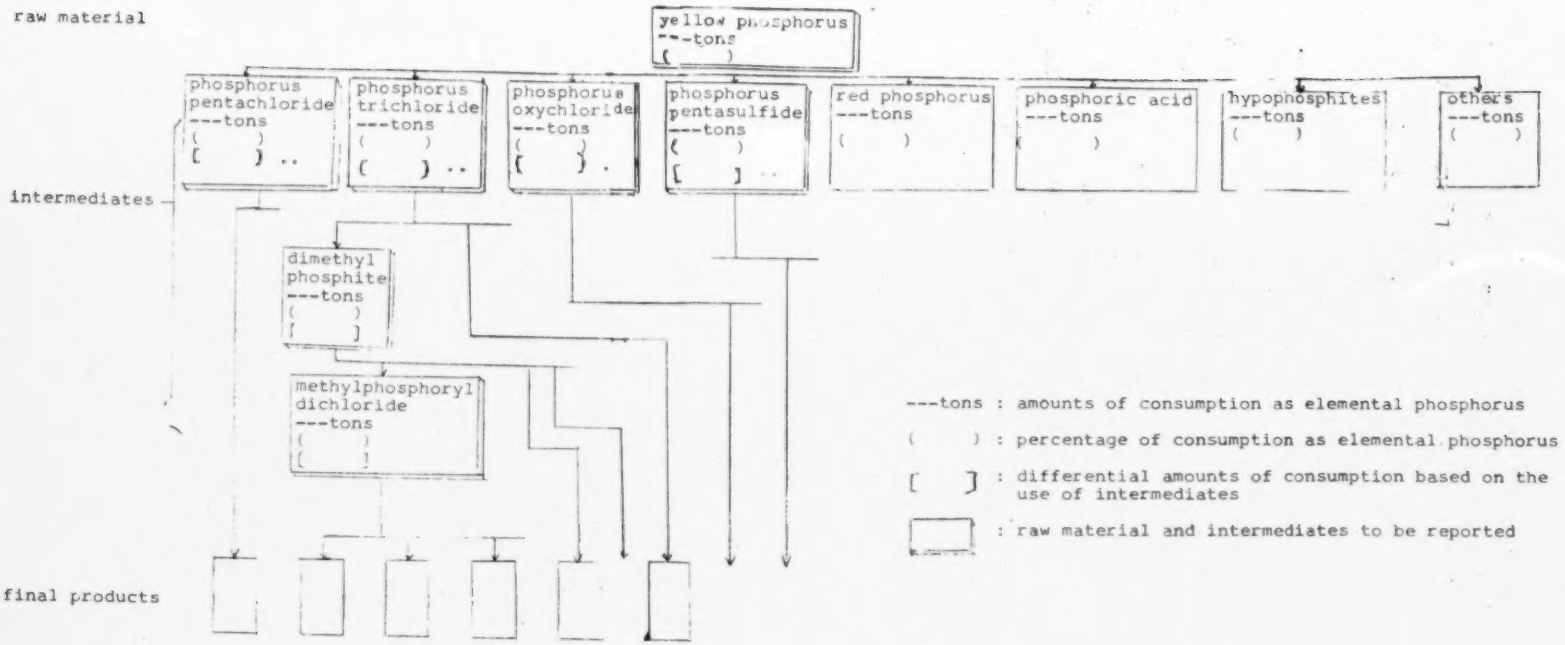


Table 3. Statistical data of production, imports, consumption & shipment of raw material & intermediates.

(ton/year)

amounts of seven substances		year			
		X	x + 1	X + 2	X + 3
yellow phosphorus	amount of stock at the end of the previous financial year amount of production amount of imports				
	total				
	amount of consumption amount of shipment amount of stock at the end of the present financial year				
	total				
phosphorus trichloride	the same as above				
phosphorus oxychloride					
phosphorus pentachloride					
phosphorus pentasulfide					
dimethyl phosphite					
methylphosphoryl dichloride					

CONFERENCE OF THE COMMITTEE ON DISARMAMENT

CCD/431
16 July 1974
Original: ENGLISH/RUSSIAN

UNION OF SOVIET SOCIALIST REPUBLICS
AND UNITED STATES OF AMERICA

TREATY BETWEEN THE UNITED STATES OF AMERICA AND THE UNION OF SOVIET SOCIALIST REPUBLICS ON THE LIMITATION OF UNDERGROUND NUCLEAR WEAPON TESTS

The United States of America and the Union of Soviet Socialist Republics, hereinafter referred to as the Parties,

Declaring their intention to achieve at the earliest possible date the cessation of the nuclear arms race and to take effective measures toward reductions in strategic arms, nuclear disarmament, and general and complete disarmament under strict and effective international control,

Recalling the determination expressed by the Parties to the 1963 Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water in its preamble to seek to achieve the discontinuance of all test explosions of nuclear weapons for all time, and to continue negotiations to this end,

Noting that the adoption of measures for the further limitation of underground nuclear weapon tests would contribute to the achievement of these objectives and would meet the interests of strengthening peace and the further relaxation of international tension,

Reaffirming their adherence to the objectives and principles of the Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water and of the Treaty on the Non-Proliferation of Nuclear Weapons,

Have agreed as follows:

ARTICLE I

1. Each Party undertakes to prohibit, to prevent, and not to carry out any underground nuclear weapon test having a yield exceeding 150 kilotons at any place under its jurisdiction or control, beginning 31 March, 1976.

2. Each Party shall limit the number of its underground nuclear weapon tests to a minimum.

3. The Parties shall continue their negotiations with a view toward achieving a solution to the problem of the cessation of all underground nuclear weapon tests.

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ARTICLE II

1. For the purpose of providing assurance of compliance with the provisions of the Treaty, each Party shall use national technical means of verification at its disposal in a manner consistent with the generally recognized principles of international law.

2. Each Party undertakes not to interfere with the national technical means of verification of the other Party operating in accordance with paragraph 1 of this Article.

3. To promote the objectives and implementation of the provisions of this Treaty the Parties shall, as necessary, consult with each other, make inquiries and furnish information in response to such inquiries.

ARTICLE III

The provisions of this Treaty do not extend to underground nuclear explosions carried out by the Parties for peaceful purposes. Underground nuclear explosions for peaceful purposes shall be governed by an agreement which is to be negotiated and concluded by the Parties at the earliest possible time.

ARTICLE IV

This Treaty shall be subject to ratification in accordance with the constitutional procedures of each Party. This Treaty shall enter into force on the day of the exchange of instruments of ratification.

ARTICLE V

1. This Treaty shall remain in force for a period of five years. Unless replaced earlier by an agreement in implementation of the objectives specified in paragraph 3 of Article I of this Treaty, it shall be extended for successive five-year periods unless either Party notifies the other of its termination no later than six months prior to the expiration of the Treaty. Before the expiration of this period the Parties may, as necessary, hold consultations to consider the situation relevant to the substance of this Treaty and to introduce possible amendments to the text of the Treaty.

2. Each Party shall, in exercising its national sovereignty, have the right to withdraw from this Treaty if it decides that extraordinary events related to the subject matter of this Treaty have jeopardized its supreme interests. It shall give notice of its decision to the other Party six months prior to withdrawal from this Treaty. Such notice shall include a statement of the extraordinary events the notifying Party regards as having jeopardized its supreme interests.

3. This Treaty shall be registered pursuant to Article 102 of the Charter of the United Nations.

Done at Moscow on 3 July, 1974, in duplicate, in the English and Russian languages, both texts being equally authentic.

For the United States of America:

The President of the United States of America
Richard Nixon

For the Union of Soviet Socialist Republics:

General Secretary of the Central Committee of the CPSU
L.I. Brezhnev

PROTOCOL TO THE TREATY BETWEEN THE UNITED STATES OF AMERICA AND THE UNION OF SOVIET SOCIALIST REPUBLICS ON THE LIMITATION OF UNDERGROUND NUCLEAR WEAPON TESTS

The United States of America and the Union of Soviet Socialist Republics, hereinafter referred to as the Parties,

Having agreed to limit underground nuclear weapon tests,

Have agreed as follows:

1. For the purpose of ensuring verification of compliance with the obligations of the Parties under the Treaty by national technical means, the Parties shall, on the basis of reciprocity, exchange the following data:

a. The geographic co-ordinates of the boundaries of each test site and of the boundaries of the geophysically distinct testing areas therein.

b. Information on the geology of the testing areas of the sites (the rock characteristics of geological formations and the basic physical properties of the rock, i.e., density, seismic velocity, water saturation, porosity and depth of water table).

c. The geographic co-ordinates of underground nuclear weapon tests, after they have been conducted.

d. Yield, date, time, depth and co-ordinates for two nuclear weapon tests for calibration purposes from each geophysically distinct testing area where underground nuclear weapon tests have been and are to be conducted. In this connexion the yield of such explosions for calibration purposes should be as near as possible to the limit defined in Article I of the Treaty and not less than one-tenth of that limit. In the case of testing areas where data are not available on two tests for calibration purposes, the data pertaining to one such test shall be exchanged, if available, and the data pertaining to the second test shall be exchanged as soon as possible after a second test having a yield in the above-mentioned range. The provisions of the Protocol shall not require the Parties to conduct tests solely for calibration purposes.

2. The Parties agree that the exchange of data pursuant to subparagraphs a, b, and d of paragraph 1 shall be carried out simultaneously with the exchange of instruments of ratification of the Treaty, as provided in Article IV of the Treaty, having in mind that the Parties shall, on the basis of reciprocity, afford each other the opportunity to familiarize themselves with these data before the exchange of instruments of ratification.

3. Should a Party specify a new test site or testing area after the entry into force of the Treaty, the data called for by subparagraphs a and b of paragraph 1 shall be transmitted to the other Party in advance of use of that site or area. The data called for by subparagraph d of paragraph 1 shall also be transmitted in advance of use of that site or area if they are available; if they are not available, they shall be transmitted as soon as possible after they have been obtained by the transmitting Party.

4. The Parties agree that the test sites of each Party shall be located at places under its jurisdiction or control and that all nuclear weapon tests shall be conducted solely within the testing areas specified in accordance with paragraph 1.

5. For the purposes of the Treaty, all underground nuclear explosions at the specified test sites shall be considered nuclear weapon tests and shall be subject to all the provisions of the Treaty relating to nuclear weapon tests. The provisions of Article III of the Treaty apply to all underground nuclear explosions conducted outside of the specified test sites, and only to such explosions.

This Protocol shall be considered an integral part of the Treaty.

Done at Moscow on 3 July, 1974.

For the United States of America:

The President of the United States of America
Richard Nixon

For the Union of Soviet Socialist Republics:

General Secretary of the Central Committee of the CPSU
L.I. Brezhnev

PROTOCOL TO THE TREATY BETWEEN THE UNITED STATES OF AMERICA AND THE UNION OF SOVIET SOCIALIST REPUBLICS ON THE LIMITATION OF ANTI-BALLISTIC MISSILE SYSTEMS

The United States of America and the Union of Soviet Socialist Republics, hereinafter referred to as the Parties,

Proceeding from the basic principles of relations between the United States of America and the Union of Soviet Socialist Republics signed on 29 May 1972,

Desiring to further the objectives of the Treaty between the United States of America and the Union of Soviet Socialist Republics on the Limitation of Anti-Ballistic Missile Systems signed on 26 May 1972, hereinafter referred to as the Treaty,

Reaffirming their conviction that the adoption of further measures for the limitation of strategic arms would contribute to strengthening international peace and security,

Proceeding from the premise that further limitation of anti-ballistic missile systems will create more favourable conditions for the completion of work on a permanent agreement on more complete measures for the limitation of strategic offensive arms,

Have agreed as follows:

ARTICLE I

1. Each Party shall be limited at any one time to a single area out of the two provided in Article III of the Treaty for deployment of anti-ballistic missile (ABM) systems or their components and accordingly shall not exercise its right to deploy an ABM system or its components in the second of the two ABM system deployment areas permitted by Article III of the Treaty, except as an exchange of one permitted area for the other in accordance with Article II of this Protocol.

2. Accordingly, except as permitted by Article II of this Protocol: The United States of America shall not deploy an ABM system or its components in the area centered on its capital, as permitted by Article III (a) of the Treaty, and the Soviet Union shall not deploy an ABM system or its components in the deployment area of intercontinental ballistic missile (ICBM) silo launchers as permitted by Article III (b) of the Treaty.

ARTICLE II

1. Each Party shall have the right to dismantle or destroy its ABM system and the components thereof in the area where they are presently deployed and to deploy an ABM system or its components in the alternative area permitted by Article III of the

Treaty, provided that prior to initiation of construction, notification is given in accord with the procedure agreed to by the Standing Consultative Commission during the year beginning 3 October 1977 and ending 2 October 1978, or during any year which commences at five year intervals thereafter, those being the years for periodic review of the Treaty, as provided in Article XIV of the Treaty. This right may be exercised only once.

2. Accordingly, in the event of such notice, the United States would have the right to dismantle or destroy the ABM system and its components in the deployment area of ICBM silo launchers and to deploy an ABM system or its components in an area centered on its capital, as permitted by Article III (a) of the Treaty, and the Soviet Union would have the right to dismantle or destroy the ABM system and its components in the area centered on its capital and to deploy an ABM system or its components in an area containing ICBM silo launchers, as permitted by Article III (b) of the Treaty.

3. Dismantling or destruction and deployment of ABM systems or their components and the notification thereof shall be carried out in accordance with Article VIII of the ABM Treaty and procedures agreed to in the Standing Consultative Commission.

ARTICLE III

The rights and obligations established by the Treaty remain in force and shall be complied with by the Parties except to the extent modified by this Protocol. In particular, the deployment of an ABM system or its components within the area selected shall remain limited by the levels and other requirements established by the Treaty.

ARTICLE IV

This Protocol shall be subject to ratification in accordance with the constitutional procedures of each Party. It shall enter into force on the day of the exchange of instruments of ratification and shall thereafter be considered an integral part of the Treaty.

Done at Moscow on 3 July 1974, in duplicate, in the English and Russian languages, both texts being equally authentic.

For the United States of America:

The President of the United States of America
Richard Nixon

For the Union of Soviet Socialist Republics:

General Secretary of the Central Committee of the CPSU
L.I. Brezhnev

JOINT STATEMENT ON ENVIRONMENTAL WARFARE

The United States of America and the Union of Soviet Socialist Republics:

Desiring to limit the potential danger to mankind from possible new means of warfare;

Taking into consideration that scientific and technical advances in environmental fields, including climate modification, may open possibilities for using environmental modification techniques for military purposes;

Recognizing that such use could have widespread, long-lasting, and severe effects harmful to human welfare;

Recognizing also that proper utilization of scientific and technical advances could improve the inter-relationship of man and nature;

1. Advocate the most effective measures possible to overcome the dangers of the use of environmental modification techniques for military purposes.

2. Have decided to hold a meeting of United States and Soviet representatives this year for the purpose of exploring this problem.

3. Have decided to discuss also what steps might be taken to bring about the measures referred to in paragraph 1.

Moscow, 3 July 1974

For the United States of America:

The President of the United States of America
Richard Nixon

For the Union of Soviet Socialist Republics:

General Secretary of the Central Committee of the CPSU
L.I. Brezhnev

CONFERENCE OF THE COMMITTEE ON DISARMAMENT

CCD/432
16 July 1974
Original: ENGLISH

LETTER DATED 12 JULY 1974 FROM THE PERMANENT REPRESENTATIVE OF FINLAND TO THE SPECIAL REPRESENTATIVE OF THE SECRETARY-GENERAL TO THE CONFERENCE OF THE COMMITTEE ON DISARMAMENT TRANSMITTING A WORKING PAPER BY THE GOVERNMENT OF FINLAND

ON METHODOLOGY FOR CHEMICAL ANALYSIS AND IDENTIFICATION OF CW AGENTS - PROGRESS OF A FINNISH RESEARCH PROJECT

Upon instructions from my Government, I have the honour to enclose a Working Paper by the Government of Finland to the Conference on Disarmament with the request that you would take appropriate steps to have it distributed in the Conference of the Committee on Disarmament.

Enclosed please find also a matrice for the printing of some illustrative figures attached to the Working Paper.

(Signed) Klaus A. Sahlgren
Permanent Representative
of Finland

GE.74-67423
74-23001

WORKING PAPER BY THE GOVERNMENT OF FINLAND TO THE CCD

Methodology for chemical analysis and identification of CW agents

- Progress of a Finnish research project

1. In 1972, the Government of Finland announced a project on creation on a national basis of a CW control capacity for possible future international use (CCD/381). This working paper noted that at least initially the work would focus mainly on organophosphate nerve agents while some work would also be done on mustards. In a subsequent working paper (CCD/412) the Finnish Government described in some detail the scientific activities connected with the project, the instrumental methods used and the laboratories engaged in this research. One of the goals of the project was to be an analytical handbook for CW verification, a compilation of standardized data for the identification of various CW agents, especially organophosphates and mustards, as well as their precursors, metabolites and degradation products.

This paper presents a more detailed description of the methods chosen and illustrates with a few examples the data obtainable by these methods. The figures included in this working paper also suggest a format for the presentation of such data for verification purposes.

2. The need for national verification activities and their international standardization has been stressed in several working papers of the CCD, e.g., the draft convention (CCD/361) and the working paper (CCD/403) submitted by the socialist states, while the need and role of international verification has been stressed, e.g., in the working paper of the non-aligned countries (CCD/400) and the recent draft convention submitted by Japan (CCD/420).

3. Among the different verification methods in the context of a CW-treaty, chemical analyses have obviously an essential role among the verification techniques. For this purpose national and international control laboratories capable of analysing previously unknown components even at ppm or ppb level in multicomponent mixtures are needed. Such requirements can be met by combining the techniques of environmental residue studies with modern methods of structure analyses. Whatever the solution of the verification question or the agreed combination of national and international means of verification, such data must be obtained by internationally agreed, standardized methods and reported in an internationally agreed, unambiguous format to fulfill the requirements of international comparability and criticality.

Concerning the nerve agents (sarin, VX etc.) the enzymatic method for detection of anticholinesterase compounds is the most sensitive indicator. If, however, there is need for more knowledge of the structure of the agent or if some other kind of CW agent (e.g., a mustard) is in question, other methods must apply. In many cases the compound to be identified is not even the agent itself but a metabolite, degradation product or precursor of it. The methods of classical chemical analysis often demand too much time or material, but the modern physical methods -- mass spectrometry, infrared spectrometry (IR), and nuclear magnetic resonance spectrometry (NMR) -- have been found more suitable.

By preparation of the samples the reactivity of the agents has to be taken into account, so that the extraction and the purification have to be made with caution, the physical methods like chromatography, ion exchange and gel filtration being the methods of choice.

In order to find out the suitability of these analytical methods in respect of CW verification, each research group engaged in the Finnish project has concentrated on the study of one of them. In addition, various organophosphorus esters, halogenides and other model compounds have been synthezised, and the kinetics of the formation and decomposition reactions have been studied.

4. In analysis of CW agents gas, liquid and thin layer cromatography are perhaps the most used methods. The detection level of a picogram may be reached using electron capture and alkali salt flame ionization detectors and also by the use of photoelectric detectors (sensitive to phosphorus and sulfur compounds). Chromatograms are suitable for quantitative evaluation when the agents in question is previously known. The identification of an unknown compound from a chromatogram peak needs more structure analytical measures; the retention time of a component alone is not a very realiable evidence.

5. At present, mass spectrometry connected to gas chromatography is the most sensitive method for structure analysis of components in an unknown mixture of organic compounds; spectra from nanogram quantities are obtainable. By using glass capillary columns in gas chromatograph-mass spectrometer also a very efficient separation of the components can be performed. Time needed for the analysis is quite short if an ON LINE computer connected to the mass spectrometer is available. As an example a spectrum of sarin is presented in Figure 1.

6. NMR spectrometry, especially the ^{13}C and ^{1}H resonances, is perhaps the most effective method for obtaining knowledge of the structure of an unknown organic compound without reference material. Concerning nerve gases, also ^{31}P and ^{19}F resonances are very valuable. The main limitation of the use of NMP in residue analyses has been the low sensitivity. The present fast progress in this field will remove part of this limitation. At present, proton and fluorine megnetic resonance spectra from microgram samples are obtained by using pulse Fourier techniques with ON LINE computer. As an example ^{1}H and ^{13}C spectra of sarin are illustrated in Figures 2 and 3.

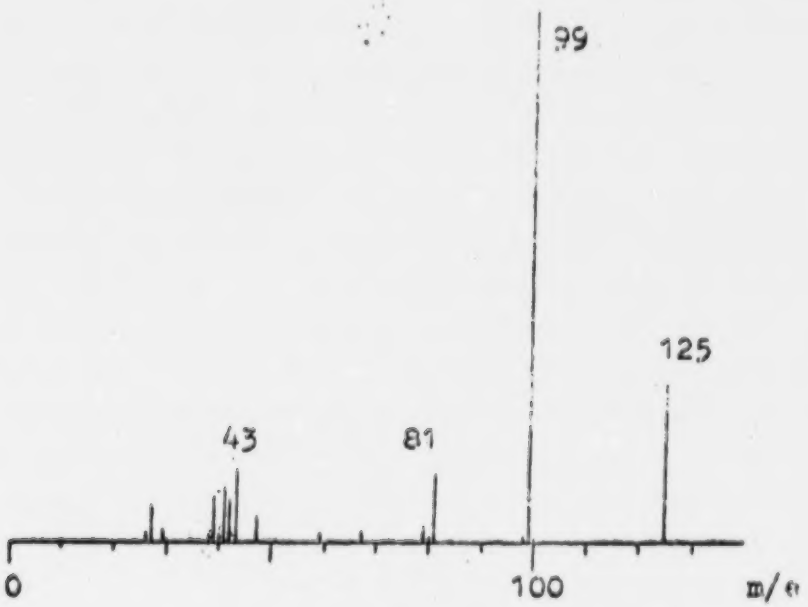
7. Infrared spectrometry (IR) is an analytical method which gives structural information about skeleton type and functional groups of previously unknown molecules. Alone it is a useful method of identification when large reference collections like the Sadtler or the Hummell & Scholl Catalogues are available. Without such collections IR often is not able to give the final structural formula but it is a fast and cheap method for fingerprint classification of unknown materials. There are now available data for over 5600 organophosphorus compounds and their empiric correlations. IR gives further straight information on the bonds of molecules in some cases where mass spectrometry and NMR spectrometry can give only secondhand information, for instance in thiono -- thiolo isomerism. It is possible to extend the sensitivity of IR spectrometry down to microgram level by using special techniques. Samples of pure components can be collected by preparative chromatography. In addition to low instrumental expenses another advantage of the infrared spectrometry is that it is also suited for the mobile laboratory purposes. In Figure 4 the IR spectrum of sarin is presented.

8. For the chemical control work it is extremely important to know how these compounds behave in different open air conditions. Therefore the Finnish project has investigated the hydrolysis and alcoholysis reactions of phosphoromono- and dichloridates after they have first been synthesized. For this purpose a quick, safe and sensitive method was developed, in which conductivity changes caused by hydrogen chloride are measured during the reaction. A model reaction is presented in Figure 5, where the shares of different components are plotted against reaction time. It is evident from the figure that the reaction rate of the chlorine atoms are not equivalent. The reaction scheme is given in the Figure, too.

In respect of the enzymatic detection method for anticholinesterase agents the toxicology-group has confirmed, using the method of Ellman, that in cases of toxification caused by organophosphorus compounds the cholinesterase activity of human blood and cerebellum is remarkably diminished and well verifiable. In animals, the cholinesterase activity of blood is too weak for realiable evaluation of alterations, whereas in small animals as rats and mice, the activity of brain (cerebrum or/and cerebellum) is sufficient for studying the effects of anticholinesterase poisons.

10. It is evident that none of the analytical methods examined will be satisfactory alone. One has to choose several of the best methods, or maybe use all of them to complement each other. In any case, however, a large collection of reference data will be very helpful even if not quite necessary. For this purpose the Finnish project has started to collect all the analytical information obtained during the work concerning chemical agents, e.g., the chromatographic and kinetic information as well as mass-, IR- and NMR-spectra of the compounds. As mentioned earlier (CCD 412/73) a handbook containing such information would be helpful for verification purposes both in its national and international aspects. It is hoped that the Finnish project will make a contribution towards that end.

Fig. 1. Mass spectrum of the nerve agent sarin with a proposed scheme for the fragmentation



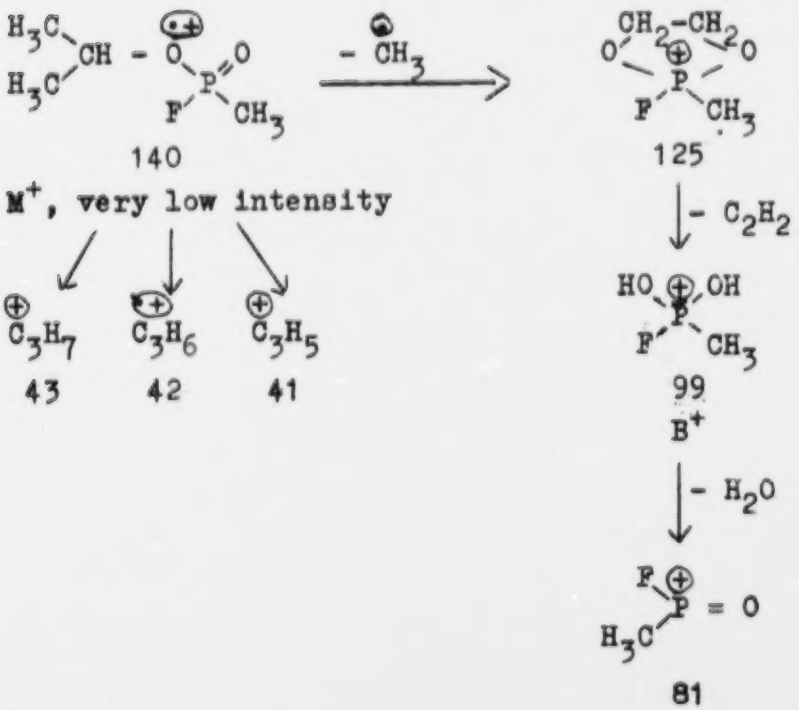


Fig. 2. ^{1}H resonance spectrum of sarin in deuterochloroform

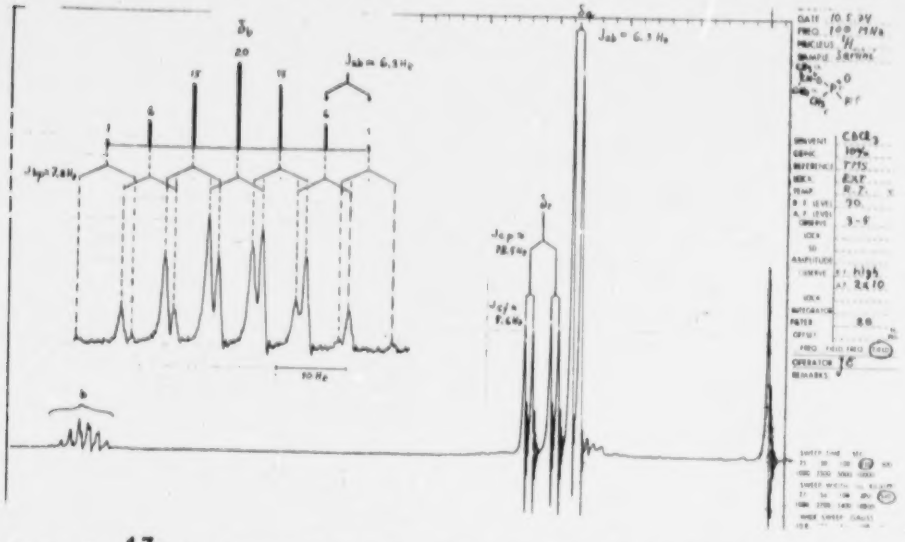


Fig. 3. ^{13}C resonance spectrum of sarin in deuterochloroform

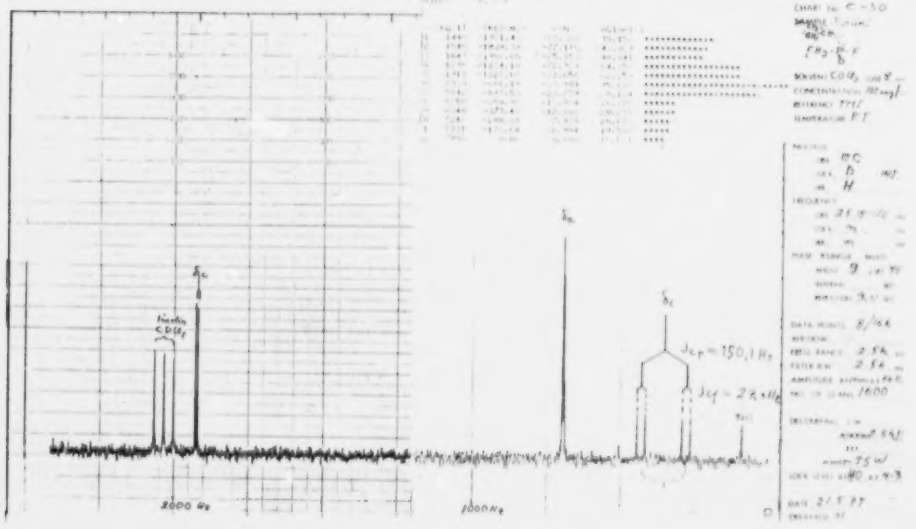


Fig. 4. Infrared spectrum of sarin, solventfree film between KBr plates

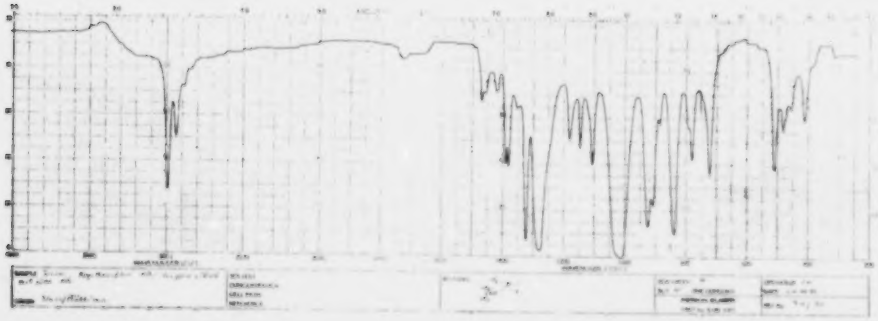
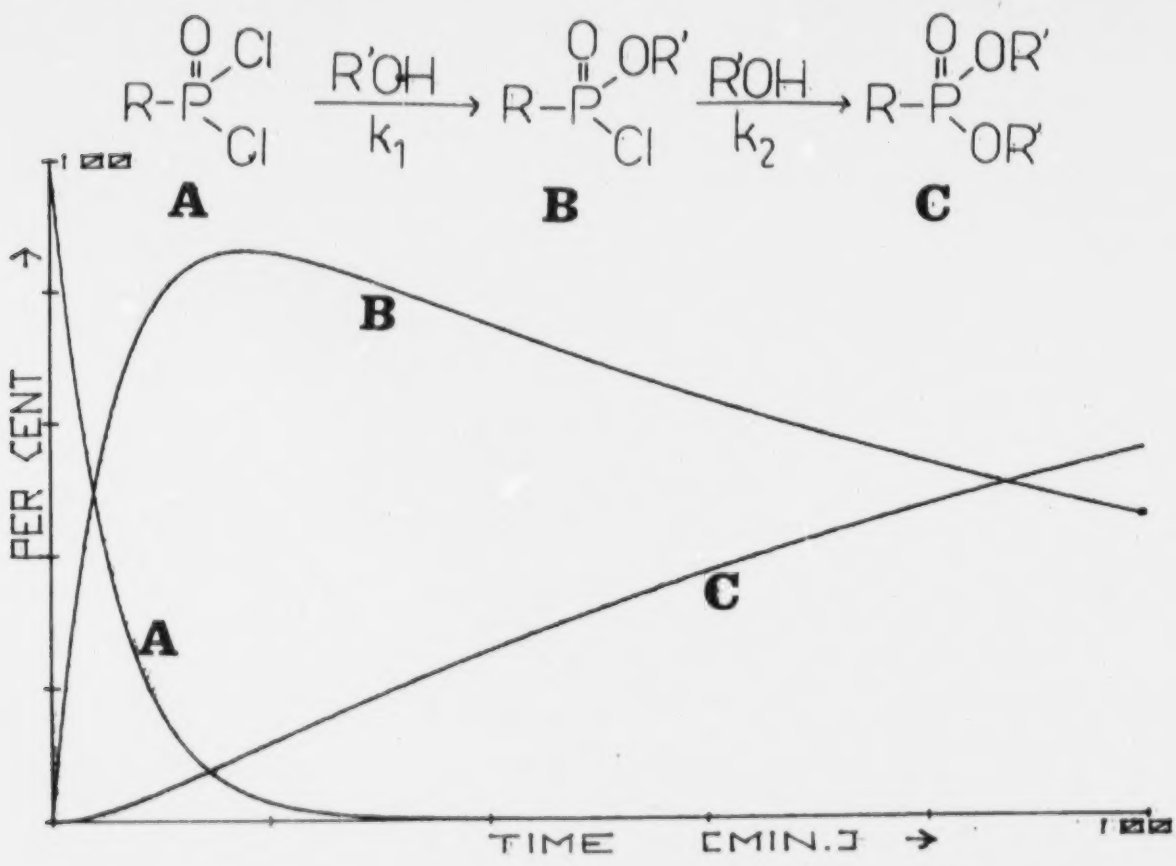


Fig. 5. Kinetics of the alcoholysis of an alkylphosphonodichloride



CONFERENCE OF THE COMMITTEE ON DISARMAMENT

CCD/433
16 July 1974
Original: ENGLISH

CANADA

The problem of defining compounds having military significance as irritating and incapacitating agents

Introduction

1. This paper is to be considered as a supplement to CCD/414 in that the same scheme of definition has been applied to those chemical substances that depend primarily on their irritating or incapacitating effect for their possible military utility.

Non-lethal Agents

2. Attention is drawn to the meaning of some of the terms used in this paper:

harassing or irritating means having a physiological effect which will render individuals incapable of normal concerted physical effort during exposure and only for a very short period of time (minutes) after exposure ceases. These are generally known as riot control agents;

incapacitating means having physiological or mental effects which will render individuals incapable of normal concerted physical or mental effort or both for a significant period of time after exposure. Such agents resemble riot control agents in that the effects are temporary and without permanent damage but are different in that the effect may last for hours or in extreme cases for days.

3. It is necessary to stress the difference in agents that cause the above effects: the first are those that are immediately and physically irritating (e.g. tear gas), and whose effects last only for a short period after exposure. The second type are those that are mentally or physically incapacitating for a significant period of time after exposure ceases. Because of the lack of perceptible signs of the presence of such agents, the effects of these agents may not be observed until after an incapacitating dose has assimilated.

4. Some agents generally categorized as harassing agents have a toxicity which would place them above the lower threshold of toxicity set out in Table I.[1/] The military

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1/ As in CCD/414 but amended.

utility of harassing and incapacitating agents is related, however, not to their possible lethal effects, but to their irritating and incapacitating effect. It remains to determine, therefore, a threshold of irritating or incapacitating effectiveness above which these chemical substances can be considered as having military utility.2/

5. Annex B of the Report of the Secretary-General of the United Nations on Chemical and Bacteriological Weapons (Document A/7575 or S/9292) tabulates the effectiveness of the irritating agents in terms of a tolerance limit. For the purpose of this paper, a different quantitative unit is used, the effective median dosage, in order to be consistent with the dosage used for lethal agents. The dosage of those that are known is shown in Table II. From this it can be seen that a threshold can be drawn at a value of about 200 mg.min/m^3 for the median dosage. Because those at present available are relatively cheap and simple to manufacture, the incentive to produce new non-lethal agents may not be great. It cannot be ruled out, however, that new agents might be discovered that would not be as efficient as those at present known. To allow for this, it is proposed to lower this threshold to a value of 500 mg.min/m^3, the same level as for the upper threshold of the lethal agents. Since all these agents are single purpose, this suggests that these substances could then be described as a class of "super effective" single purpose non-lethal agents. It is difficult to say whether this threshold value should be lowered even further. However, it is perhaps instructive to note that 80 proof whisky has an equivalent median incapacitating dosage of about 1,500 mg.min/m^3. Since alcohol is not an efficient weapon of war, it seems reasonable to state that the threshold for non-lethal agents is probably somewhere between the values of 1,500 and 500 and is probably close to 500 mg.min/m^3 for practical purposes.

6. Therefore, as a suggested definition, it is possible to state that: a chemical compound or element can be considered as a potential agent of war if it has a median incapacitating or irritating dosage of less than 500 mg.min/m^3.

Use of agent definitions in establishing scope of prohibition

7. Thresholds have been suggested which separate those chemical substances which have military potential based on their effectiveness to incapacitate or irritate from those that do not have such a potential. (Some of the chemical substances thus defined as being potential agents of war also have recognized peaceful uses.)

2/ Non-lethal agents are discussed in the Report of the Secretary-General of the United Nations on Chemical and Bacteriological Weapons (Document A/7575 or S/9292) where they are described in the broad category of incapacitating agents. (This working paper restricts the meaning to that given in the introduction in which the qualification, "for a significant period of time", is important.)

8. The non-lethal agents can be defined, according to the duration of their effects on exposed personnel, as being either irritating or incapacitating.

9. In the case of harassing or irritating agents which are widely recognized as essential for civil riot control because of their quick reaction and short duration without injury, it is unlikely that governments would be preared to ban their continued development, production and stockpiling. It might on the other hand be generally accepted that the development, production and stockpiling of incapacitating agents could be prohibited. This acceptance would stem from the unreliability and unpredictable effects of incapacitating agents, particularly the psychochemicals. It would seem unlikely that governments would wish to retain such agents for civil police use. In the event of there being a disposition to prohibit incapacitating agents but to allow irritating agents for civil use, an expert review committee could determine into which category fell those chemicals above the agreed threshold of effectiveness.

TABLE I

Classification of some chemical compounds and elements based on toxicity including sub-groups based on purpose

Lethal Agents	Lct50 *	mg.min/m^3
Supertoxic (single purpose)	VX	10-50
	Sarin	100
	Soman	50-100
	Tabun	400

UPPER THRESHOLD

Mustard 1,500
Lewisite 1,500

Toxic

Araine 5,000

3,200 Phosgene Toxic
5,000 HCN

SINGLE PURPOSE
DUAL PURPOSE
**

(CN 11,000)

11,000 Cyanogen Chloride

(Adamsite 15,000)

19,000 Chlorine

LOWER THRESHOLD

All other chemicals that have no significant military value

* Dosage vapour concentration multiplied by time of exposure lethal to 50 per cent of exposed personnel.

** Chemicals having both military and civil use.

TABLE II

Classification of some chemical compounds based on Irritiating and Incapacitating dosages

Non-lethal Agents

Irritating CT50 **	mg.min/m^3	Incapacitating Ct50 **
CS 10-20		
Arsine Derivatives 10-30		
CN 80		
		BZ > 200
	THRESHOLD	

Effectiveness of chemicals in this range not of military interest

** Dosage vapour concentration multiplied by time of exposure Irritating or Incapacitating to 50 per cent of exposed personnel.

CONFERENCE OF THE COMMITTEE ON DISARMAMENT

CCD/433/Corr.1
19 July 1974

ENGLISH, RUSSIAN and
SPANISH ONLY

CANADA

The problem of defining compounds having military significance as irritating and incapacitating agents

Corrigendum

On page 2, fifth line, "Annex B" should read "Annex III".

GE.74-67634
74-23006

CONFERENCE OF THE COMMITTEE ON DISARMAMENT

CCD/434
16 July 1974
Original: ENGLISH

CANADA

Destruction and disposal of Canadian stocks of World War II Mustard Agent

Historical background

1. Shortly after the outbreak of the Second World War, many countries, including Canada, produced a supply of chemical warfare agents in anticipation of their possible use during the war in retaliation of enemy gas attacks. Gas warfare was never employed, and while most chemical stocks were destroyed in Canada, some quantities of mustard agent remained in storage.

Present Status

2. In Canada approximately 700 tons of mustard agent in bulk liquid form have been retained since 1942 at the Canadian Defence Research Establishment Suffield, at Ralston, Alberta. This material has been stored in reinforced concrete, lead-lined vaults, and no appreciable degradation of the vaults or the mustard has occurred up to the present time. The mustard was primarily HS (2,2'-dichloro-diethyl sulfide) of approximately 70 per cent purity, with a small stock of a more persistent type of mustard referred to as HT. For many years, Canadian Government policy has been to maintain no offensive capability or weaponry in chemical warfare; consequently the mustard was of no use to the Canadian Forces, and a decision was made several years ago to find a safe, effective, clean and economical method of disposing of it.

Methods for destruction of Mustard

3. A number of possible methods for disposing of the mustard were considered. These included: burning the mustard in open pits (as was done in a number of countries after the Second World War) -- this was environmentally undesirable because of the resultant air pollution; dumping it in the ocean -- this was unacceptable for several reasons, including international agreements on ocean dumping; burning the mustard in an existing or specially designed incinerator and scrubbing or dispersing air pollutants from the exhaust gas stream -- this was technically feasible, but very costly and involving some handling hazards; and chemical processes to convert the mustard to a less hazardous or innocuous form, and disposal of the resultant product in an acceptable manner.

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74-23008

4. The last approach appeared most promising. In the laboratory, mustard was converted to a solid (dithiane) by reaction with sodium sulfide. The solid was easier to handle and less hazardous, but the process was abandoned because of the cost of the sodium sulfide, the environmental problems of disposing of the large volume of dithiane produced, and the engineering problems of avoiding the trapping of unreacted mustard in the solid end product. Conversion of the mustard by hydrolysis to a relatively harmless liquid was also investigated, along with disposal methods for the liquid product. This approach was successful in the laboratory and pilot-plant scale experiments, and was considered technically feasible for bulk destruction.

5. It was generally known that mustard/water mixtures were non-reactive, since hydrolysis did not occur to any significant degree; yet other measurements indicated that mustard which was dissolved in water reacted quickly, with a reaction time equivalent to a mustard half-life of 8-10 minutes at 25°C. A detailed study of this apparent discrepancy led to the discovery that, with the addition of a base to control pH, elevation of the temperature above ambient, and turbulent mixing, water and mustard would react readily to produce a non-vesicant mixture of salts and thiodiglycol. This process was optimized in laboratory experiments, and in pilot-plant scale batch experiments involving up to 50 gallons of mustard per batch. A number of bases were studied for pH control and calcium hydroxide was chosen as the optimum and least expensive. A plant has been designed and built to hydrolyze up to about 7 tons of mustard per batch under the control of a two-man crew.

6. This plan is now operational, and mustard is being destroyed. Full scale trials have demonstrated that the process is non-hazardous and fully effective in destroying the mustard.

Disposal of Mustard Hydrolysate

7. The hydrolysate produced during experimental destruction of batches of mustard contained water, thiodiglycol, calcium salts (primarily calcium chloride) and some polysulfides. Disposal methods studied for this hydrolysate included: incorporation of the hydrolysate in concrete to form a solid; incorporation in landfill; spreading on soil with natural biodegradation; microbial deterioration in a reaction vessel; and high temperature incineration. While natural biodegradation processes appeared promising, insufficient time was available to optimize and prove the environmental acceptability of the method. Studies were therefore concentrated on thermal destruction processes. Several thousand gallons of hydrolysate were incinerated successfully in an existing high-temperature furnace, which was originally designed to burn DDT (ac

DDT/kerosene solutions) and which included a scrubbing tower. Using natural gas as an auxiliary fuel, the hydrolysate was incinerated, and the resultant gaseous effluents, except for a small quantity of sulfur dioxide, were removed in the scrubbing tower. A smokestack was erected to disperse the remaining sulfur dioxide into the atmosphere so that clean air standards could be met. The scrubbing tower water was neutralized with calcium hydroxide and recirculated.

Final Mustard disposal system

8. In the destruction process which is now underway, the mustard hydrolysis is being carried out in the specially designed remotely controlled facility which has been mounted directly on top of the storage vaults. The reaction of each batch (about 7 tons of mustard) is complete in about six hours. One batch can thus be destroyed in one working day. The process is economical, efficient and non-hazardous.

9. Following laboratory verification of reaction completion, the hydrolysate is drained into an interim storage tank, or directly into trailer-mounted tanks for hauling to the incinerator, which is located approximately one mile from the reactor.

10. At the incinerator, the hydrolysate is pumped under pressure into an atomizing nozzle and dispersed into a natural gas flame. Combustion rates of up to 2½ gallons per minute may be achieved under optimum conditions. Thermal destruction of the hydrolysate at the rate of about 35 tons (mustard equivalent) per week is expected.

CONFERENCE OF THE COMMITTEE ON DISARMAMENT

CCD/435
16 July 1974
Original: ENGLISH

UNITED STATES OF AMERICA

Working Paper on toxicity of chemical warfare agents

Modern lethal chemical warfare agents are exceedingly toxic substances, much more toxic for the most part than the chemicals in common industrial use. Because of this difference, it has been suggested that the degree of toxicity is a logical choice as one possible criterion for defining chemical warfare agents for the purpose of an arms control agreement.

As noted in the work programme presented by the United States delegation (CCD/360), there are several different approaches to the question of definition, each with its own advantages and disadvantages. A criterion based on a toxicity limit would have the advantage of being directly related to the potential danger from a particular substance. It would be applicable to known super-toxic substances or any super-toxic substance discovered in the future. However, compounds which are less toxic might still have utility either as chemical warfare agents or agent precursors. Among these are mustard-type compounds, dual-purpose agents such as phosgene (carbonyl chloride), hydrogen cyanide, and cyanogen chloride, and binary precursors. If a prohibition is to cover all lethal agents it might be necessary to adopt a general-purpose criterion and perhaps other criteria in addition to a toxicity criterion.

Considerable progress has already been made in working out the technical aspects of a practical toxicity criterion. Concrete proposals for a toxicity criterion have already been presented by the delegations of Japan (CCD/301, CCD/374) and Canada (CCD/387, CCD/414). Both delegations adopted a similar approach by proposing a criterion based on the toxicity of a particular agent. Soman was suggested as a "boundary agent" by the Japanese delegation and tabun by the Canadian delegation.

As our delegation and others have noted, a toxicity value for a compound is meaningful only if the experimental conditions under which it was measured are specified in detail. For this reason, in order to establish a practical toxicity criterion, it would be necessary to define not only the toxicity level, but also the animal to be used for measurement and the route by which the chemical is administered.

Experimental Animal

The military utility of CW agents is related to toxicity to humans. Theoretically a toxicity criterion would be based on human reactions to chemical agents. Obviously, however, experimental animals must be used instead to measure the toxicity values.

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74-23011

In general, the assumption that a compound that is super-toxic to experimental animals will will also be very dangerous to humans is a sound one. In toxicological studies, a variety of different animals are commonly used. As noted in Table 1, toxicity values vary somewhat from one species to another. Therefore, a toxicity threshold must be tied to a specific animal.

Table 1. Toxicity of Tabun to Experimental Animals*/

Animal	LD_{50} (mg/kg)**/
Mouse	0.35 - 0.40
Rat	0.16
Guinea Pig	0.13 - 0.3
Rabbit	0.3 - 0.5
Cat	0.10
Goat	0.3

*/ Subcutaneous administration: United States Army data

**/ The LD_{50} is the dose which is lethal to 50 per cent of a group of animals (median lethal dose).

Route of Administration

The toxicity of an agent may vary depending on the route by which it is administered to the test animal. Chemicals are commonly administered orally or by inhalation or introduced directly by injection ("parenteral" administration). The most common parenteral routes of administration are into a blood vein (intravenous), into the abdominal fluid (intraperitoneal), into a muscle (intramuscular) or beneath the skin (subcutaneous). Percutaneous administration involves application on the skin. The variation in toxicity with route of administration is illustrated for tabun in Table 2.

Table 2. Influence of Route of Administration on Toxicity of Tabun */

Route of Administration	LD_{50} (mg/kg)
Intravenous	0.10 - 0.15
Intraperitoneal	0.66 - 0.9
Subcutaneous	0.35 - 0.40
Percutaneous	1.0 - 2.8

*/ Taking a mouse as the experimental animal; United States Army data.

Unfortunately, it is not possible to convert the value obtained by one route of administration to an equivalent value for a different route. As shown in Table 3, the relative values for different routes of administration vary from compound to compound.

Since the military potential of super-toxic compounds is often closely related to their inhalation toxicity, it would seem logical to establish a criterion based on inhalation toxicity as proposed in CCD/414. Some chemicals, however, are not super-toxic when inhaled, but would be extraordinarily toxic if they were carried into the body by a projectile which penetrated the skin. Included in this category are super-toxic carbamates. For this reason a criterion based on inhalation toxicity would not be sufficient.

The toxicity criteria proposed in CCD/374 are based on subcutaneous or intra-peritoneal injection. These routes of administration are generally applicable to any compound and are less difficult from a technical standpoint than administration by the respiratory route.

It would be possible to supplement a criterion based on inhalation toxicity with one derived from parenteral toxicity. However, it would be simpler to rely on parenteral toxicity alone, since any compound that is super-toxic on inhalation will also be super-toxic by a parenteral route.

To some extent the selection of a particular experimental animal and a given parenteral route of administration in defining the criterion is arbitrary. The choice might best be made simply according to the relative amount of data available for the different situations. It appears that more data, particularly on known CW agents, are available for the mouse (subcutaneous administration) than for other animals and other routes of administration listed in Table 4.

Judging from the data in Table 4, there appears to be little overlap between single-purpose super-toxic CW agents and dual-purpose chemicals. Ideally, the toxicity criterion should be defined so as to separate the two groups cleanly. It probably will be impossible to do so. However, establishing an LD_{50} value of 0.50 mg/kg (mouse; subcutaneous administration) as the limit, as suggested in CCD/301, or a value close to 0.50 mg/kg, may be the optimal solution to the problem of selecting a suitable level.

Experimental Variability

In order for toxicity measurements from different laboratories to be consistent with each other, the detailed experimental procedures must be standardized. Some of the conditions which would have to be established are listed in CCD/374. If general agreement were reached to adopt a prohibition based on a specific toxicity threshold, the precise experimental procedures could undoubtedly be worked out by experts in toxicology.

Table 3. Relative Toxicity Values for Several Results of Administration */

Route of Administration	Procaine LD_{50} (mg/kg) (Mouse)	Procaine Relative Value	Isoniazid LD_{50} (mg/kg) (Mouse)	Isoniazid Relative Value	DFP **/ LD_{50} (mg/kg) (Rabbit)	DFP **/ Relative Value	Pentobarbital LD_{50} (mg/kg) (Mouse)	Pentobarbital Relative Value
Intravenous	45	1	153	1.0	0.34	1.0	80	1.0
Intraperitoneal	230	5	132	0.9	1.00	2.9	130	1.6
Intramuscular	630	14	140	0.9	0.85	2.5	124	1.5
Subcutaneous	800	18	160	1.0	1.00	2.9	130	1.6
Oral	500	11	142	0.9	4 to 9	11.7 to 26.5	280	3.5

*/ from T.A. Loomis, Essentials of T xicology, Lea and Febiger, Philadelphia, 1968.

**/ DFP = diisopropylfluorophosphate

Table 4. Mouse Toxicity Data (Subcutaneous Administration)

Compound */	Toxicity (LD_{50}, mg/kg)	Source
3152 CT (carbamate)	0.005 (i.v., dog)	Funke, Depierre and Krucker, 1952
VX	0.022	U.S. Army
VE	0.025	U.S. Army
VM (edemo)	0.035	U.S. Army
VS	0.035	U.S. Army
GB (sarin)	0.04	CCD/374
GB (sarin)	0.06 - 0.15	CCD/374
GD (soman)	0.1	CCD/374
GF	0.11 - 0.20	U.S. Army
GD (soman)	0.125	U.S. Army
GB (sarin)	0.15	U.S. Army
VG (amiton, tetram)	0.155 (male)	U.S. Army
GB (sarin)	0.173	CCD/374
GB (sarin)	0.2	CCD/374
GB (sarin)	0.214	Askew, 1957
GB (sarin)	0.22	CCD/374
GE (ethly sarin)	0.301	U.S. Army
GA	0.35 - 0.40	U.S. Army
neostigmine (prostigmine) **/	0.42	U.S. Army
echothiophate **/	0.50	Schaumann, 1960
neostigmine methylsulfate **/	0.51	Brown et al, 1950
neostigmine iodide **/	0.55	Brown et al, 1950
paraoxon **/	0.6 - 0.8	CCD/374
paraoxon **/	0.7	Augustinsson, 1953; Schaumann, 1960
neostigmine (prostigmine) **/	0.8	Toxic Substances List, 1973
TEPP (tetraethylpyrophosphate) **/	0.85	U.S. Army
HN-1	1.1 - 2.05	U.S. Army
physostigmine salicylate **/	1.24	Brown et al, 1950
paraoxon-ME **/	1.4	CCD/374
HN-3 **/	2.01 (HCl)	U.S. Army
colchicine **/	2.3 - 3.8	U.S. Army

Mouse Toxicity Data (Subcutaneous Administration)

Compound	(Toxicity (LD_{50}, mg/kg)	Source
metasystox (methyldemeton) **/	2.9 - 3.3	CCD/374
potassium cyanide **/	2.9 - 6.0	U.S. Army
DFP **/	3.2 - 4.7	U.S. Army
DFP **/	4	Toxic Substances List, U.S. Dept. of HEW, 1973
HN-2 **/	4.5	U.S. Army
methyl fluorcacetic acid **/	5 - 19	U.S. Army
sulfotepp **/	8	CCD/374
parathion **/	10 - 12	CCD/374
parathion **/	"	Holmstedt, 1963
mustard gas (H)	20 - 30	U.S. Army
methylparathion **/	30	Helmstedt, 1963
cyanogen chloride (CK) **/	39	U.S. Army

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*/ The structures of military CW agents listed here are given in CCD/365.

**/ Commercial chemicals

However, even if procedures are standardized, there will be a certain amount of variability in the measurements. It is to be expected that two laboratories using identical samples of chemical will still obtain slightly different toxicity values. This is because it is difficult to control precisely all the variables involved in making toxicity tests on animals.

In making toxicity measurements, a range of 20 per cent on either side of the average value is usually considered good. Studies on the reproducibility of oral toxicity values have demonstrated that a broader range should normally be expected. The ratio of the highest to lowest value is likely to be between 1.5 and 3 for oral toxicity values and may be as high as 10. (For parenteral toxicity values, the range may be somewhat smaller). Usually, the LD_{50} value reported is the average of a range of values.

The variability of toxicity values could pose a problem in applying a treaty prohibition in certain cases. Normally only one or two independent values will be available, and it is quite possible that these values will differ greatly from the average value that would be obtained from a large number of independent determinations. For a particular compound, one laboratory might report the compound to be more toxic than the limit while a different laboratory might conclude that it is less toxic.

This difficulty may be illustrated by assuming that the toxicity criterion has been defined to be an LD_{50} of 0.50 mg/kg (mouse; subcutaneous administration) and that a standardized experimental procedure has been adopted. For a compound with an average LD_{50} value of 0.36 mg/kg, which is below the limit, the possible results from different laboratories range approximately from 0.18 mg/kg to 0.54 mg/kg. If the value reported is greater than 0.50 mg/kg, it might be argued that the compound should not be prohibited. Analogously, for a compound which would have an average LD_{50} value of 0.80 mg/kg, which is well above the 0.50 mg/kg limit, a single laboratory might report a value as low as 0.40 mg/kg. In this case, prohibition might well be advocated.

Obviously, some differences may arise about application of the prohibition to a specific compound even if a toxicity criterion is established. One possible way to help resolve such differences would be to have an appropriate independent laboratory measure the toxicity.

Super-Toxic Dual-Purpose Compounds

As noted above, it is unlikely that a toxicity criterion can be found that will cleanly separate single-purpose super-toxic CW agents from dual-purpose chemicals. A few dual-purpose compounds are likely to be more toxic than the limit established by the toxicity criterion. The data in Table 4 indicate that most of these compounds will be drugs. Strict application of the toxicity criterion would lead to a ban on

these super-toxic dual-purpose compounds. However, super-toxic drugs are produced in very small quantities and are not well suited as chemical warfare agents. It might be useful to consider application of the criterion in such a way that super-toxic drugs would not be prohibited. This might be accomplished by allowing super-toxic chemicals to be produced in quantities necessary for legitimate use as a drug if the use as a drug had been demonstrated beforehand.

CONFERENCE OF THE COMMITTEE ON DISARMAMENT

CCD/436
16 July 1974
Original: ENGLISH

UNITED STATES OF AMERICA

Working Paper on chemical agent destruction

In a previous working paper (CCD/367) the United States delegation described the environmental protection and safety procedures involved in current United States operations for demilitarizing limited quantities of chemical weapons. The example discussed was the planned demilitarization and disposal of nerve agent cluster bombs.

This paper describes in detail the actual procedures employed in disposal of mustard gas at Rocky Mountain Arsenal near Denver, Colorado, an operation that was completed in March 1974. Possible methods of verification of the disposal operation are also discussed. We hope that this information on the characteristics of actual disposal operations will be useful to the Committee in its consideration of verification of chemical agent destruction.

Background

In the fall of 1968 the Department of the Army decided to dispose of certain chemical agents and munition stocks, including the mustard agent stored at Rocky Mountain Arsenal near Denver, Colorado. These mustard stocks amounted to 3701 tons and were stored as bulk in containers which hold approximately 0.9 ton of agent.

In response to an Army request a proposed plan for disposal at sea was reviewed in the Summer of 1969 by a panel of experts under the auspices of the National Academy of Sciences. These experts, drawn primarily from leading industrial, educational and research institutions, recommended that the bulk mustard agent at Rocky Mountain Arsenal be destroyed by incineration.

This recommendation was adopted by the Army. A plan for disposal by incineration w was prepared and made public. It was reviewed by interested agencies, as required under the National Environmental Protection Act and revised. A final statement of the plan was made public in early July 1971.

Small-scale disposal operations were initiated shortly after the final statement was filed. During this stage of the operations, the disposal equipment was tested and minor changes in the disposal plan were made in order to resolve the few difficulties encountered. Full scale disposal operations began in September 1972.

GE.74-67428
74-23013

Outline of Disposal Plan

Mustard gas decomposes rapidly at about 425°C to produce three gases - sulphur dioxide, carbon dioxide and hydrogen chloride. In the disposal operation, the mustard was destroyed by incineration. The incineration products were removed from the exhaust stream and converted to harmless salts.

Steps of the Disposal Plan

(1) Transfer of agent containers. The agent containers were stored in the toxic agent area at Rocky Mountain Arsenal. This area was under continuous security guard surveillance and the mustard containers were visually inspected for leakage by depot personnel (daily during warm weather and every three days during cool weather. Prior to removal from the area, the containers were checked for any possible liquid leakage by using a standard detection paper that changes color when exposed to mustard. They were then loaded on a flat bed truck and were transported under security guard escort to the mustard plant area for disposal. As a safety precaution a decontamination truck followed the loaded truck.

(2) Unloading and Thawing. Upon arrival at the mustard disposal facility, the containers were unloaded and placed in a thaw room where they remained for at least 48 hours at a temperature between 40°C and 60°C. The thaw room, as well as other areas of the facility where a potential hazard from mustard vapor existed, were maintained under a negative pressure. Since mustard gas freezes between 5° and 15°C it was heated in the thaw room to get as much as possible of the solid residue from the bottom of the container into solution. The rare liquid leaks that occurred during this 2-day period were trapped in a sump where they were decontaminated with a standard military decontaminant that reacts rapidly with mustard and achieves complete decontamination in about five minutes. These liquids were subsequently checked to ensure absence of mustard, added to the spent scrubber brine, and spray dried.

Any vapors which were generated were vented through the duct in the floor of the thaw room and removed from the air by an absolute filter system with essentially 100 per cent efficiency.

(3) Draining of Containers. From this thaw room the containers were taken to the unloading booths by overhead crane, placed inside the booths and remotely attached to an evacuating hose. The mustard then was drawn off under vacuum. Determination of the quantity of mustard removed from the container was accomplished by weighing the container before and after the operation.

(4) Incineration of Agent. The mustard which had been removed from the container was pumped into a holding tank from which it was later pumped to the incinerator. It arrived at the incinerator through double-walled piping and was sprayed into the incinerator where it was heated to temperatures of 750° to 875°C for 0.3 second, thus thermally decomposing it completely. At peak effeciency the disposal rate was over 7 litres per minute.

(5) Scrubbing of Effluent Gases. In the incineration process sulphur dioxide and hydrogen chloride are generated. To wash these pollutants out of the effluent gases, the gases were passed through a scrubber system where they were brought into contact with a solution of sodium hydroxide, a strong caustic. This resulted in a brine solution of inorganic salts: sodium sulphate, sodium sulphite, sodium chloride, and sodium carbonate. This salt solution was then evaporated to dryness and the residue of salts compacted. A test was performed periodically to verify that the salts contained no mustard.

The effluent gases were then passed through an electrostatic precipitator to remove particulate matter (mostly ferric oxide resulting from corrosion of the steel containers) before being exhausted from the stack.

(6) Disposal of Salts. The compacted salts were transported in lined 55-gallon drums to a warehouse where they remain in storage pending final disposition. No decision has yet been made on the best method for disposal of the salts. Approximately 4000 tons of salt were generated during the operation.

(7) Decontamination and Disposal of Containers. Prior to removal from the booth where it was emptied, each container was inspected and externally decontaminated if required. It was then moved to a temporary storage area. During the incineration of the bulk agent a separate incinerator furnace was used to decontaminate the containers.

In this process a container was removed from the storage area. Upon arrival at the furnace area, two holes were remotely punched in the container to provide ventilation and release of combustion gases in lieu of removing valves and plugs. Following this operation, the containers were placed in the furnace, where any residual

Following cooling, quality control personnel checked the container with standard detection material to assure that all traces of mustard had been removed before it was transported to the holding area. The containers will be recycled as scrap metal.

Verification of Agent Destruction

In the disposal process described in the preceding sections, opportunities for verification appear to exist at several points. It must be kept in mind, however, that the characteristics of the disposal process may vary according to the type of agent being destroyed, whether the agent is stored in bulk or in munitions, and the safety and environmental regulations which must be followed.

Verification of disposal might be conducted in a variety of ways, depending upon the degree of access accorded verification personnel. At one extreme, verification might be limited to remote observation via closed-circuit television with no access to the facilities themselves. At the other extreme, unrestricted inspection of the disposal site might be permitted, including unrestricted access to all buildings and records and analysis of chemical samples.

In the paragraphs that follow, verification of disposal will be discussed using the United States procedure for disposal of bulk mustard agent as an illustration.

(a) Steps 1 and 2: Transfer of agent containers, unloading and thawing. In these steps there may be several indicators that toxic chemical agents are being handled. A few of the most recognizable indicators are:

a. Decontamination equipment readily available.

b. Workers in protective clothing and equipped with protective masks.

c. Toxic agent warning sign attached to vehicle.

d. Security measures, including a security escort front and rear when travelling.

By their nature these indicators would be easily observed. However, they could also easily be staged and their value for verification is therefore questionable.

(b) Step 3: Draining of Containers. This step provides the first opportunity for positive assurance that a toxic chemical agent is present. This assurance can be achieved, however, only if full access to the facility is allowed. During the draining phase of the process, it would be feasible to tap the drain line to the storage tank. A small (10 ml) sample of liquid could be withdrawn and analysed to determine the type and concentration of agent. This would provide positive verification that agent was being drained from the container.

(c) Step 4: Incineration of Agent. Verification at this step could provide the best assurance that toxic chemical agent is actually being destroyed. In the destruction of the mustard agent, the agent is transferred from the storage tank to the furnace

through a single pipe. A tap valve could be installed in this pipe at the point just before the mustard is injected into the furnace for burning. As in the previous step, a sample could be withdrawn and analysed as to the type of agent and its concentration. Data over a period of time could be compared with data from the previous step to ensure the agent had not been diluted (part diverted and another liquid substituted).

Analysis of the salts could provide another method of verification. This might be considered less intrusive than sampling and analysis of the agent itself. A mustard gas molecule contains one sulphur atom and two chlorine atoms. No other chlorine or sulphur compounds are involved in the disposal process. As a result, there should be a 2 : 1 ratio between chlorine and sulphur atoms in the salts. The salts resulting from mustard disposal at Rocky Mountain Arsenal have been analysed and found to have the approximately expected ratio.

A third method of verification might be to try to obtain a materials balance. Records would be needed for the quantity of agent to be destroyed, amount of caustic being added, and total weight of the end product salts. It is possible to calculate the amounts of salts which should be produced from disposal of a given quantity of a specific agent. For this method to work, there would have to be no loss of gases, liquid or solids, from the system. In other words, the system would have to be totally contained. This was not the case at Rocky Mountain Arsenal. As is typical of incineration, minor losses of gases were anticipated and did occur in the process (mostly sulphur dioxide being exhausted from the stack), which altered somewhat the total weight of salts produced as well as the relative quantities of the different compounds.

To assist in the materials balance procedure it would be useful to have a flowmeter line transferring agent from the holding tanks to the furnace.

(c) Steps 5-7: Scrubbing of Effluent Gases; Disposal of Salts; Decontamination Disposal of Containers. In the case of mustard disposal, these steps did not appear to provide any important additional opportunities for verification of destruction.

Preliminary Comments and Conclusions

(1) There are several indicators which could provide some assurance to observers that disposal operations were being carried out.

(2) A number of means for misleading observers exist, including the staging of indicators and substitution of an industrial chemical for agent.

(3) A high degree of assurance that no evasion is taking place during the disposal process could be obtained through technical methods of inspection.

CONFERENCE OF THE COMMITTEE ON DISARMAMENT

CCD/437
16 July 1974
Original: ENGLISH

UNITED STATES OF AMERICA

Working Paper on diversion of commercial chemicals for weapons

As many delegations, including our own, have noted, there are three major categories of substances related to chemical warfare:

(1) Single-purpose agents. These agents have no large-scale use for prophylactic, protective or other peaceful purposes. This category includes the super-toxic organophosphorus nerve agents, as well as some less toxic agents which have no important peaceful applications.

(2) Dual-purpose agents. Chemicals in this category have important civilian applications, but might also be used as CW agents. Many of the CW agents used in World War I are in this group, including phosgene (carbonyl chloride), chlorine and hydrogen cyanide.

(3) Precursors. Chemical compounds used as intermediates in the production of super-toxic agents may or may not have civilian application. For example, phosphorus trichloride, a key precursor in the production of organophosphorus nerve agents, is widely used as an intermediate in the manufacture of pesticides and plasticisers. On the other hand, another important precursor, methylphosphonic dichloride, is not currently used in producing commercial organophosphorus chemicals (but could be in the future).

This suggests that verification of a ban on production of CW agents has two major aspects: (a) ensuring that single-purpose CW agents and single-purpose precursors are not being produced and (b) making certain that dual-purpose agents and dual-purpose precursors are not being diverted to non-peaceful purposes.

Several delegations have suggested that statistical monitoring of chemical production could play an important role in deterring diversion of dual-purpose chemicals to prohibited military uses. Under this approach, data on the production and consumption of raw materials and intermediates would be analysed to ensure that no diversion occurred. The United States delegation presented some preliminary conclusions

GE.74-67432
74-23016

and comments on this approach in a previous working paper (CCD/311, 25 August, 1970). At that time we noted that there were certain problems and disadvantages to be overcome, particularly in regard to identifying deliberate attempts at deception.

The United States has continued its research on economic data monitoring in an effort to overcome some of the shortcomings identified in CCD/311. This paper is based on a study sponsored by the US Arms Control and Disarmament Agency, entitled "The Role of Phosphorus Control in Verification of a Ban on Nerve Agent Production: An Economic and Technical Analysis", carried out by Midwest Research Institute (Kansas City, Missouri).

Control System for Phosphorus

Among the potential CW agents, super-toxic organophosphorus compounds are generally considered to pose the greatest danger. The structure of these agents and possible processes for producing them may vary widely; however, phosphorus is the one substance which is a key input for manufacture of any organophosphorus agent. This suggests that production of such agents might be prevented by establishing controls over elemental phosphorus and any phosphorus compounds which could serve as precursors ("divertible" phosphorus compounds). Controls would not cover "non-divertible" compounds.

A control system might be established to monitor the production, storage, transportation and use of all phosphorus compounds which can be used in the production of a nerve agent. The objective would be to ensure that all consumption of divertible phosphorus compounds could be traced to legitimate activities. To accomplish this task, the industrial enterprises which handle these materials would be required to maintain detailed internal records and to prepare periodic reports on all relevant activities. In addition, all transfers between plants of this kind would have to be documented by records prepared by the shipper, the carrier and the consignee. To ensure the accuracy of these industry-level reports, several types of checks would be incorporated into the system.

The administration and operation of the control system could be divided among several levels -- industry, national control agencies and an international control agency. Industrial enterprises would be required to follow authorized material handling procedures, maintain adequate accounting records and report to the national control agency. The national body would have primary responsibility for applying the controls to enterprises which are within the territory of the state involved, or are under its jurisdiction or under its control anywhere. Verification that all industrial establishments have complied with all provisions of the control system would be provided

by the national body to the international control agency. The international agency would oversee the entire system, analyse and audit reports from each national agency and monitor the international trade of controlled materials.

Verification

In order to provide a reasonable degree of assurance that no diversion is occurring, such a control system would need to be designed so that the accuracy of reports from industrial establishments and from the national control agencies could be verified. There appear to be three basic verification techniques which could be used by the control agencies to determine the accuracy of reports: (1) analysis of statistical information presented in the reports, (2) examination and analysis of records, and (3) technical inspection. In this paper the discussion will focus on the verification activities of the international control agency.

The first step taken by the international control agency to verify the system's reporting accuracy would be analysis of the reports submitted by the national control agencies and perhaps by certain industrial enterprises. This would include review of the statistical data to ensure that all quantities balanced and that they were in line with those expected.

Periodically the international control agency would audit relevant records of national control agencies. In addition they would have the authority to conduct audits of national control agencies and individual industrial enterprises at any time to resolve discrepancies. While the procedures which would be followed are very similar to those employed in conducting a financial audit, they would, of course, be concerned with quantities of phosphorus and their disposition.

It would be necessary to develop a reliable system based on technical inspection for detecting false records. The types of technical inspection which could be employed are: (1) visits to certain chemical plants, (2) technical analysis of plant operating data, (3) analysis of samples of phosphorus-containing chemicals which are in inter-plant transit, and (4) monitoring of metering devices which provide independent information on plant production rates.

Evasion.

There are two principal ways in which evasion could occur. Either the phosphorus material would be diverted from within the system or it would be obtained from sources outside the system's control. For evasion techniques which operate within the system, records and reports at the industry and national level would be changed to avoid detection from discrepancies, or imbalances, in the reports. By definition, evasions outside the system have no effect on the records and would have to be detected by other means.

Possible Methods of Evasion Within The Control System

The possible means of evasion within the control system which have been identified in our studies are summarized below:

1. An elemental phosphorus plant understates the production of phosphorus and diverts the excess to an agent plant.

2. A multi-product plant reports an incorrect production mix between divertible and non-divertible phosphorus compounds.

3. A plant overstates the production of a non-divertible item and diverts an equivalent amount of input material.

4. The amount of phosphorus in a product is overstated by a plant.

5. An establishment reports high loss rates of divertible material or low efficiencies in production processes which use divertible materials.

6. A plant uses wet process phosphoric acid (not produced from elemental phosphorus) to produce material and reports the production as using "furnace acid" (phosphoric acid produced from elemental phosphorus).

7. A country diverts small amounts of phosphorus from a large number of plants.

8. A plant fails to register its phosphorus recovery process.

9. A nerve agent plant registers as a legitimate industrial phosphorus user.

A detailed examination of the United States phosphorus industry has revealed the following concerning potential evasions within the control system:

1. The greatest potential for obtaining phosphorus for CW agent production appears to be diversion of elemental phosphorus. Diversion from the phosphorus production plant would require less record modification and would be more difficult to detect than other diversion methods.

2. Exports of elemental phosphorus and production of white phosphorus munitions, the only major end uses of phosphorus in the elemental (white) form, are also potentially major points for diversion.

3. Recovering significant quantities of phosphorus for agent production by reprocessing chemical end products appears to be the least feasible of the evasion procedures considered.

Evasions Outside of the Control System

Evasion might occur outside the control system in several ways:

1. An elemental phosphorus plant does not register with the control agency.

2. Nerve agent precursors are produced directly from phosphate rock, rather than from elemental phosphorus.

3. Phosphorus material for agent is recovered from an end use product.

4. Phosphorus material is imported from a country which is outside of the control system.

5. Phosphorus or phosphorus-containing precursors are stockpiled prior to agreement.

6. Demilitarization of obsolete chemical munitions or agents which are not entered into the system.

Preliminary Evaluation of Effectiveness

The verification technique discussed in this paper differs significantly from the economic data monitoring technique discussed previously (CCD/311) in that provisions for technical inspection have been incorporated. In the new approach, statistical data provide the background for combined use of audit and technical inspection procedures. This technique increases the utility of economic data monitoring since the audit and technical inspection procedures complement one another.

While conventional on-site inspections would be useful in some circumstances, they would not be highly effective in detecting some very important kinds of evasion within the system. For example, diversion of phosphorus from an elemental phosphorus plant is unlikely to be detected by observation of plant activities. At the time of the inspection the plant authorities most probably would not try to divert any phosphorus.

However, an unconventional kind of technical inspection might be effective in detecting certain kinds of diversion, including that illustrated in the previous example. This technique would combine a technical analysis of plant operating records with conventional records auditing procedures. The technical analysis would consist of a correlation of reported production figures with such data as (a) consumption of starting materials, (b) production of by-products, and (c) electrical power consumption. This type of audit would not necessarily be performed on-site; however, access to complete plant records would be required.

Two other kinds of technical inspection could also be very useful: (a) the analysis of samples obtained from inter-plant shipments, and (b) the metering of the production of elemental phosphorus and phosphoric acid. These techniques might help detect certain kinds of diversion that could not be detected any other way. For example, production metering would be the best way to prevent an attempt to divert phosphorus at an elemental phosphorus plant by misstating actual production. Chemical analysis of samples of phosphoric acid would help forestall efforts to substitute "wet process" acid (produced from phosphate rock) for "furnace" acid

(produced from elemental phosphorus) and then divert the unused phosphorus to agent production. "Wet process" acid contains relatively large amounts of impurities, which are not present in "furnace" acid.

For the control system to provide any deterrent to the diversion of phosphorus to nerve agent production, three specific measures should be provided in the operation of the system. First, the international control agency should have access to reports from individual enterprises. This is important because the statistical analysis of the reports submitted by an individual plant is one of the principal methods of detecting the diversion of phosphorus material. National reports would not contain sufficient detail to enable the international agency to detect statistically the material diverted by several of the possible evasion methods.

Second, the international control agency should be allowed to conduct an investigation of a plant's records. Unless an independent investigation is possible, evasion of the system would not be difficult. The risk of detection by an investigation could substantially increase the deterrent effectiveness of the system.

Third, technical inspection should be an integral part of the data validation procedure. A standard records audit would not be sufficient to verify the accuracy of the records.

A phosphorus control system, with the verification provisions discussed in this paper, could probably ensure that large quantities of phosphorus-containing chemicals were not being diverted from commercial channels to weapons purposes. In itself this capability would not be sufficient to provide adequate assurance of compliance. Diversion of some significant quantities could still be accomplished by a determined evader. In all likelihood, however, phosphorus would not be diverted from commercial channels but rather obtained from sources not subject to the control system.

Phosphorus monitoring could play a useful role in verifying compliance with a production ban, although further verification measures would also be needed.

CONFERENCE OF THE COMMITTEE ON DISARMAMENT

CCD/438
1 August 1974
Original: ENGLISH

SWEDEN

Underground nuclear test activities in the United States and the Soviet Union from 1969 to 1973

1. The aim of this working paper is to report on the recent test-activities in the United States and the Soviet Union and to discuss the estimated yields of these explosions in relation to the threshold of 150 kt agreed upon in the treaty on the limitation of underground nuclear weapon tests. The number of announced, or by seismological means detected, underground explosions in the two countries during the years 1969-1973 is presented here below, together with yield estimates based on generally available seismological data.

2. The United States has, according to official announcements, carried out 86 underground nuclear explosions during these five years. Three of these explosions were announced as a part of the Plowshare project for peaceful uses of nuclear explosions. The yields and positions of these peaceful explosions have been released. Eighty-one of the remaining explosions have been conducted at Nevada Test Site and two on Amchitka Island. Seismometric data have been obtained and reported from all 86 explosions. Such data also indicate that at least 18 more explosions, which were not officially announced by the United States have been carried out at Nevada Test Site, thereby bringing the total number of explosions in the United States to at least 104 in 1969-1973.

3. The Soviet Union has not officially announced any nuclear explosion in the years 1969 to 1973. The United States Atomic Energy Commission has announced 56 underground nuclear explosions as having been carried out in the Soviet Union during this time. Seismometric data have been reported from these explosions and such data also indicate that in addition to explosions announced by the United States Atomic Energy Commission another 26 underground explosions have been carried out in the Soviet Union during these five years. Fifty-four of the total 82 Soviet explosions have been in test sites in Kazakhstan and on Novaya Zemlya. The remaining 28 explosions occurred in different places, mainly in the Western parts of the Soviet Union and in the Caspian and Black Sea regions. Because of their locations these explosions are here taken to be part of a Soviet programme for peaceful uses of nuclear explosions.

GE.74-68034
74-22835

4. The yield estimates are based mainly on seismometric short period amplitude and period data, reported from globally distributed stations. For a few recent events long period seismic data have been supplemented. The availability of calibration explosions, for which explosion yields and geophysical parameters of the explosion media are announced, is of crucial importance for an accurate yield determination. The availability of calibration explosions is foreseen in the recent threshold test ban treaty, through an exchange of calibration explosion data for each test site. The lack today of such calibration severely limits the accuracy of yield estimates. The need for such calibration explosions is greatest for test sites in the Soviet Union, as no yields whatsoever have been officially announced for the explosions there.

5. The United States has officially announced the yields of 12 underground nuclear explosions at Nevada Test Site in 1966 to 1968, with yields large enough to be observed at an adequate number of seismometric stations. These explosions were used as calibration explosions for estimating the yields of the Nevada Test Site explosions. Yields and other source data have also been published for two large chemical explosions in the Alma-Ata region of the Soviet Union and for two underground nuclear explosions for peaceful purposes in Uzbekistan. These four explosions were used as calibration explosions when estimating the yields of the Soviet explosions. These calibration explosions were, however, not located in any of the Soviet test sites. As the test sites and the other peaceful explosions were distributed over a very large area, considerable systematic uncertainty must be assigned to the yield estimates of the Soviet explosions.

6. The yields of the explosions at Nevada Test Site and at the Soviet test site in Kazakhstan have been estimated by a method described in a scientific report "Seismic source and transmission functions for underground nuclear explosions with known yields at Nevada Test Site", referred to in the Swedish working paper CCD/405. In the present computations more than 2,000 observations from nearly 100 seismometric stations were used. The yield estimates range by a factor of more than 1,000, from about 1 kt to more than 1 Mt. The yields of the Soviet explosions outside the Kazakhstan test site were estimated using an m_b (NOAA)-yields relation obtained from the Kazakhstan explosions and the M_s-yield relation reported in the scientific paper "Surface waves from underground explosions", reproduced in the United Kingdom working paper CCD/363/Rev.1, employing M_s observations at the Hagfors observatory in Sweden.

7. The detailed results will be published elsewhere and are only summarized here in table 1. It shows the number of explosions whose yields can be estimated with high confidence to be above respectively below the 150 kt threshold, and also the number of explosions for which reliable statement about the yield is not possible with the present data. This category is considerably larger for the Soviet than for the American explosions. The table shows that most of the explosions appeared to be well below 150 kt and that only a small fraction of them appeared to be above 150 kt.

8. Improvements of the present estimates should become possible, when the results of the yield calibration of test sites, as foreseen in the recent threshold test ban treaty between the United States and the Soviet Union are made available.

Table 1

Summary of estimated yields of underground explosions in the United States and Soviet Union in 1969-1973

	United States			Soviet Union		
	peaceful	weapons tests	all tests	peaceful yy/	at test sites	all sites
Stronger than 150 kt	-	7	7	-	8	8
Around 150 kt x/	-	8	8	5	8	13
Weaker than 150 kt	3	86	89	23	38	61

x/ This line shows the number of explosions for which available seismometric data did not permit confident statements on whether they had yields below or above 150 kt.

y/ The events in this column are listed as peaceful because they occurred in places other than the two main test sites.

CONFERENCE OF THE COMMITTEE ON DISARMAMENT

CCD/439
6 August 1974
ENGLISH
Original: ENGLISH/RUSSIAN/
SPANISH

MEXICO

Letter dated 6 August 1974 from the Leader of the delegation of Mexico to the Special Representative of the Secretary-General to the Conference of the Committee on Disarmament

My delegation considers that the contents of United Nations General Assembly document A/9293 of 8 November 1973 are of direct interest to the Conference of the Committee on Disarmament, especially in view of the contents of document CCD/431 of 16 July 1974. I should be glad, therefore, if you would kindly have it reproduced as a Conference document.

Accept, Sir, the assurances of my highest consideration.

(Signed) Alfonso García Robles
Leader of the delegation of Mexico
to the Committee on Disarmament

GE.74-68207

GENERAL AND COMPLETE DISARMAMENT

Letter dated 6 November 1973 from the representatives of the Union of Soviet Socialist Republics and the United States of America to the United Nations addressed to the Secretary-General

We have the honour of transmitting to you the texts of the Agreement between the Union of Soviet Socialist Republics and the United States of America on the Prevention of Nuclear War (annex I) and the Basic Principles of Negotiations on the Further Limitation of Strategic Offensive Arms (annex II), signed by the General Secretary of the Central Committee of the Communist Party of the Soviet Union, L.I. Brezhnev, and the President of the United States of America, Richard Nixon, in June 1973, at Washington.

We request you to circulate the texts of these agreements as an official document of the General Assembly.

(Signed) Yakov MALIK
Permanent Representative of the
Union of Soviet Socialist Republics
to the United Nations

(Signed) W. Tapley BENNETT, Jr.
Acting Permanent Representative of the
United States to the United Nations

ANNEX I

Agreement between the United States of America and the Union of Soviet Socialist Republics on the Prevention of Nuclear War

The United States of America and the Union of Soviet Socialist Republics, hereinafter referred to as the Parties,

Guided by the objectives of strengthening world peace and international security,

Conscious that nuclear war would have devastating consequences for mankind,

Proceeding from the desire to bring about conditions in which the danger of an outbreak of nuclear war anywhere in the world would be reduced and ultimately eliminated,

Proceeding from their obligations under the Charter of the United Nations regarding the maintenance of peace, refraining from the threat or use of force, and the avoidance of war, and in conformity with the agreements to which either Party has subscribed,

Proceeding from the Basic Principles of Relations between the United States of America and the Union of Soviet Socialist Republics signed in Moscow on 29 May 1972,

Reaffirming that the development of relations between the United States of America and the Union of Soviet Socialist Republics is not directed against other countries and their interests,

Have agreed as follows:

ARTICLE I

The United States and the Soviet Union agree that an objective of their policies is to remove the danger of nuclear war and of the use of nuclear weapons.

Accordingly, the Parties agree that they will act in such a manner as to prevent the development of situations capable of causing a dangerous exacerbation of their relations, as to avoid military confrontations, and as to exclude the outbreak of nuclear war between them and between either of the Parties and other countries.

ARTICLE II

The Parties agree, in accordance with Article I and to realize the objective stated in that Article, to proceed from the premise that each Party will refrain from the threat or use of force against the other Party, against the allies of the other Party and against other countries, in circumstances which may endanger international peace and security. The Parties agree that they will be guided by these considerations in the formulation of their foreign policies and in their actions in the field of international relations.

ARTICLE III

The Parties undertake to develop their relations with each other and with other countries in a way consistent with the purposes of this Agreement.

ARTICLE IV

If at any time relations between the Parties or between either Party and other countries appear to involve the risk of a nuclear conflict, or if relations between countries not parties to this Agreement appear to involve the risk of nuclear war between the United States of America and the Union of Soviet Socialist Republics or between either Party and other countries, the United States and the Soviet Union, acting in accordance with the provisions of this Agreement, shall immediately enter into urgent consultations with each other and make every effort to avert this risk.

ARTICLE V

Each Party shall be free to inform the Security Council of the United Nations, the Secretary-General of the United Nations and the Governments of allied or other countries of the progress and outcome of consultations initiated in accordance with Article IV of this Agreement.

ARTICLE VI

Nothing in this Agreement shall affect or impair:

(a) the inherent right of individual or collective self-defence as envisaged by Article 51 of the Charter of the United Nations,

(b) the provisions of the Charter of the United Nations, including those relating to the maintenance or restoration of international peace and security, and

(c) the obligations undertaken by either Party towards its allies or other countries in treaties, agreements, and other appropriate documents.

ARTICLE VII

This Agreement shall be of unlimited duration.

ARTICLE VIII

This Agreement shall enter into force upon signature.

DONE at Washington on 22 June 1973, in two copies, each in the English and Russian languages, both texts being equally authentic.

FOR THE UNITED STATES OF AMERICA:

(Signed) Richard NIXON
President of the United States
of America

FOR THE UNION OF SOVIET SOCIALIST REPUBLICS:

(Signed) L.I. BREZHNEV
General Secretary of the
Central Committee, CPSU

ANNEX II

Basic Principles of Negotiations on the Further Limitation of Strategic Offensive Arms

The President of the United States of America, Richard Nixon, and the General Secretary of the Central Committee of the CPSU, L. I. Brezhnev,

Having thoroughly considered the question of the further limitation of strategic arms, and the progress already achieved in the current negotiations,

Reaffirming their conviction that the earliest adoption of further limitations of strategic arms would be a major contribution in reducing the danger of an outbreak of nuclear war and in strengthening international peace and security,

Have agreed as follows:

First. The two Sides will continue active negotiations in order to work out a permanent agreement on more complete measures on the limitation of strategic offensive arms, as well as their subsequent reduction, proceeding from the Basic Principles of Relations between the United States of America and the Union of Soviet Socialist Republics signed in Moscow on 29 May 1972, and from the Interim Agreement between the United States of America and the Union of Soviet Socialist Republics of 26 May 1972 on Certain Measures with Respect to the Limitation of Strategic Offensive Arms.

Over the course of the next year the two Sides will make serious efforts to work out the provisions of the permanent agreement on more complete measures on the limitation of strategic offensive arms with the objective of signing it in 1974.

Second. New agreements on the limitation of strategic offensive armaments will be based on the principles of the American-Soviet documents adopted in Moscow in May 1972 and the agreements reached in Washington in June 1973; and in particular, both Sides will be guided by the recognition of each other's equal security interests and by the recognition that efforts to obtain unilateral advantage, directly or indirectly, would be inconsistent with the strengthening of peaceful relations between the United States of America and the Union of Soviet Socialist Republics.

Third. The limitations placed on strategic offensive weapons can apply both to their quantitative aspects as well as to their qualitative improvement.

Fourth. Limitations on strategic offensive arms must be subject to adequate verification by national technical means.

Fifth. The modernization and replacement of strategic offensive arms would be permitted under conditions which will be formulated in the agreements to be concluded.

Sixth. Pending the completion of a permanent agreement on more complete measures of strategic offensive arms limitation, both Sides are prepared to reach agreements on separate measures to supplement the existing Interim Agreement of 26 May 1972.

Seventh. Each Side will continue to take necessary organizational and technical measures for preventing accidental or unauthorized use of nuclear weapons under its control in accordance with the Agreement of 30 September 1971 between the United States of America and the Union of Soviet Socialist Republics.

Washington, 21 June 1973

FOR THE UNITED STATES OF AMERICA:

(Signed) Richard NIXON
President of the United States of America

FOR THE UNION OF SOVIET SOCIALIST REPUBLICS:

(Signed) L. I. BREZHNEV
General Secretary of the Central Committee, CPSU